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(DREAMS<sup>TM</sup>): UT-Digital EMS Project

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## INTRODUCTION

The development of a civilian corps of first responding emergency medical technicians (EMT) and paramedics during the past several decades, which was in many ways an extension of that which has long existed among military corpsmen, has had a very positive impact on the survival of all types of injuries and acute illnesses. The reality is, however, that the interpretation of a victim's clinical problems and therapies instituted are at this time dependent upon the individual caregiver's training, judgment, and experience. It is hypothesized that having a virtual physician present at the scene through the technology of modern telecommunications will have a favorable impact on patient outcome in many instances. Through the application of telecommunication technologies, The University of Texas Health Science Center at Houston (UTHSCH) proposes to virtually bring the physician to the scene of the incident, thereby allowing online physician evaluation and intervention.

With recent advances in telecommunication technology, it is now possible to decrease even further the time lapse between the incident and the institution of appropriate therapy utilizing digital technology to transmit real time physiologic data and two-way audio visual communications (see Figure 1). It will be possible to have physicians present on the battlefield or the highway, mentoring the first responding medical personnel which will improve outcomes in many instances through improved diagnoses, implementation of lifesaving procedures, and institution of definitive treatments. Wherever possible, new military technologies for combat casualty care will be integrated into the program.

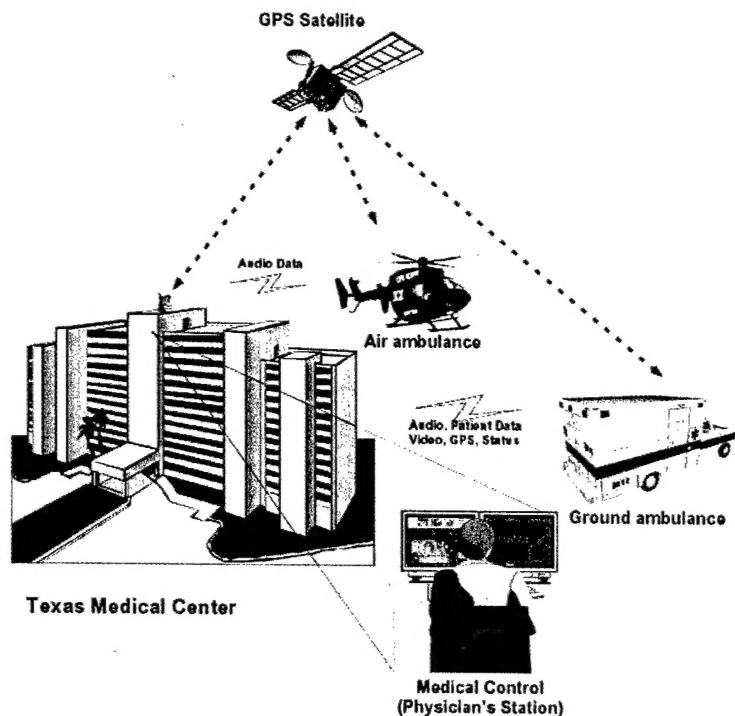


Figure 1. Digital EMS Overview

DREAMSTM builds upon an earlier United States Army Medical Research and Materiel Command (USAMRMC) DAMD 17-98-2-8002, the USAMRMC DAMD17-00-2-0010 collaborative project at The Texas A&M University System (TAMUS) (January 21, 2000), and the Advanced Research Projects Agency (ARPA) sponsored project titled "Advanced Fire Protection Technologies" (June 23, 1995). In the ARPA project, The University of Texas Health Science Center at Houston (UTHSCH) tested a prototype "Emergency Information Resource and Response Management System." This proposal is the no-cost extension to the DAMD17-98-2-8002 for the period of performance to end October 31, 2003.

## ANNUAL REPORT BODY

In line with the scope of work (SOW) for DAMD 17-01-2-0054, this report addresses each SOW item. Individual items may have references included in the appendices of this report.

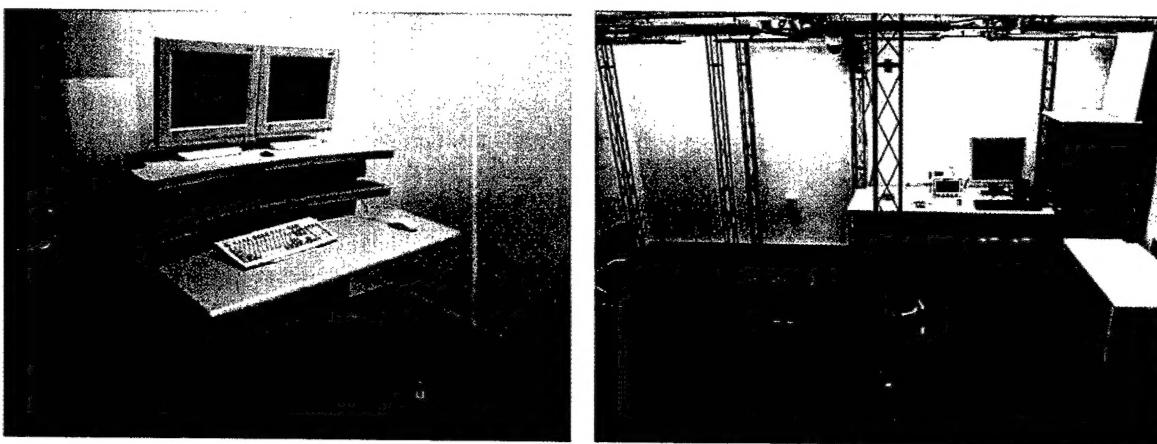
a. *Work with The Texas A&M University System (TAMUS) to Enhance Current Technologies within the Digital EMS Vehicle and Associated Hospital Systems.* UTHSCH concentrated work in two main areas to improve the vehicle systems. First, additional ambulances were put into the procurement process, and detailed medical user testing has begun on the Digital EMS software and hardware.

During the past project year, UTHSCH completed specifications for the order of 2 additional ambulances. UTHSCH has proceeded with the RFP process for the order of these 2 additional ambulances. This purchase, approved in the DAMD17-98-2-8002 no-cost extension, experienced delays due to the long build time to correct defective Ford truck chassis and due to complete new Digital EMS technical modifications for the vehicle TAMUS currently has under contract with Frazer, Inc.

Quotations have been received for the base Frazer ambulances. Orders have been placed for 2 additional Frazer units, with Digital EMS modifications to be placed under a separate order once the TAMUS modifications are complete.

Once final specification changes are completed by TAMUS on the vehicle they procured, the UTHSCH order will be placed that include modifications specific to the Digital EMS equipment planned for installation.

To improve the onboard Digital EMS systems, the UTHSCH medical user test bed was established at the Institute of Biosciences and Technology (IBT) in the Texas Medical Center, Houston. Shown in Figure 2, the medical user test bed includes a physician's workstation and a mockup of an ambulance complete with cameras and medical monitoring equipment.



**Figure 2. Medical user test bed at IBT**

Used for both medical evaluation of the onboard systems, and training for both physicians and emergency medical technicians (EMTs), the medical user test bed will prove invaluable as the project moves forward to field-testing in the coming year. Through careful study and planning for how both physicians and EMTs interact with the Digital EMS systems, better operational protocols will be developed.

The UTHSCH School of Health Information Sciences (SHIS) completed an initial user evaluation study at the end of the last year. The SHIS study focused on how a medical user (physician or EMT) would use the system, and how to make the system more user friendly. Over the past year, the UTHSCH SHIS usability team completed three major tasks.

1. Usability evaluation of Digital EMS Version 1.0. As part of a comprehensive usability project, UTHSCH conducted a heuristic evaluation of DEMS 1.0 (physician, paramedic, and driver stations). Fourteen usability heuristics were applied to identify usability problems. The 14 usability heuristics were violated 161 times (all 3 workstations combined). *Visibility* and *Consistency* are the 2 heuristics with the most violations (48 and 29, respectively). The next one is *Match* with 22 violations. There are 6 catastrophic violations that received severity ratings over 3.50—it is imperative to fix them. Forty-eight violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. Twenty-seven violations are minor violations (between 1.50 and 2.50) that have low priority in fixing. Also, there is 1 cosmetic problem that does not need be fixed unless extra time is available.

The paramedic's station has the largest number of violations (45). The physician's and driver's workstations had 19 and 18 violations identified, respectively. The average severity ratings of all 3 workstations is over 2.50, indicating that these are major usability problems that should be fixed with high priority. For every heuristic violation, a potential solution was recommended. The recommendations were well received by the developers and most of them were considered in the revision of DEMS.

2. Performed a preliminary usability evaluation of Digital EMS version 2 mockup. UTHSCH performed a heuristic evaluation of Digital EMS version 2 mockup that is being developed to target Liberty County. Fourteen usability heuristics were applied to identify usability problems. Forty-seven violations were found in the 14 usability heuristics for higher-level usability design in the mockup. *Visibility* and *Match* are the 2 heuristics with the most violations (13 and 9, respectively).

The next 2 categories are *Consistency* and *Language*, each with 7 violations. There are 2 catastrophic violations that received severity ratings over 3.50—it is imperative to fix them. Fifteen violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. Nine violations are minor violations (between 1.50 and 2.50) that have low priority in fixing. For every heuristic violation, UTHSCH recommended a potential solution.

3. Task analysis of Digital EMS version 2 mockup. SHIS performed cognitive task analyses on several tasks using the version 2 mockup. The purpose of the task analysis is to identify deeper usability problems that cannot be identified through heuristic evaluation. SHIS used hierarchical task analysis, GOMS analysis, and distributed cognition analysis as three techniques in the tasks analysis. For a task that is not well structured, an alternative was proposed that is again subject to the task analysis. The current and proposed alternatives are compared to demonstrate the problem with the existing task and the advantage of the proposed alternative. The work is still in progress.

Full reports on the SHIS evaluation are included as Appendices 1 and 2. TAMUS is currently revising the onboard software specific to the Liberty County Emergence Medical Service (LCEMS) in Liberty, Texas. This is the first of 3 planned field-testing locations, with LCEMS field deployment scheduled to begin during the first quarter of 2003. The medical user

test bed will be loaded with the revised LCEMS software once completed and will be tested for user acceptance by SHIS before field-testing begins in Liberty County, Texas.

b. *Enhance the Existing Digital EMS System to Accommodate Additional Functionality.* The Naval Research Laboratory continued its motion data collection using the ambulance gyro (and ambulance satellite terminal, or AST) mounted on a United States Marine Corps HMMWV (See Figure 3). The terminal was then installed on test bed vehicle, a 1988 Ford ambulance modified to accept the satellite terminal (See Figure 3), for further motion analysis and study.



**Figure 3. HMMWV and Satellite Test Bed Vehicles**

The AST graphical user interface (GUI) was fundamentally completed, with all modules tested and operating and providing a simple user interface. Upon direction from the project manager, no further work will be conducted on this task until the new fiscal year once interaction with Texas A&M and their software is conducted.

NRL, along with the DEMS program office, developed specifications for the Ku/Ka-band hub to be installed at UTHSCH, and also assisted in the selection process. UTHSCH released a RFP on the satellite terminal to be located on the roof of the IBT facility. Proposals were received and evaluated. The terminal contract is under negotiation currently, with installation slated to begin in early 2003.

NRL provided input on terminal performance and monitor and control software to Digital EMS team members.

The NRL GUI was developed with a multi-tiered access, to permit operators access to some layers, but to only allow technicians access to parameters that could detrimentally affect the performance of the AST. Task will be extended into FY03.

NRL continues to interact with multiple satellite vendors regarding future Ka-band opportunities, including Telesat Canada (Anik), Panamsat and Loral Skynet.

NRL has a separate funding agreement with USAMRMC. Complete documentation regarding the NRL satellite development can be found in documentation submitted under that award and is not included here.

c. *Evaluate, Select, and Coordinate Decision Support Technologies for Clinical and Non-Clinical Decision Support Needs of the Digital EMS.* No new developments regarding GLIF adoption have occurred this quarter. We will be talking with investigators at Columbia

University about GLEE (GLIF execution engine) during the AMIA Fall Symposium 2002 in November, but as a final decision on the expression language has not yet been made, no GLIF 3 execution engine can be developed. Current plans call for the re-expression of DEMS prehospital care algorithms and protocols as Arden Syntax MLMs during Q2 and Q3 of 2003. The UTHSCH Digital EMS staff has been tasked to complete this development.

d. *Evaluate and Select/Adapt Emergency Medical Data Set and Information Model for use with Digital EMS.* As a first step to the development of the information model and data set to be used on the ambulances, the Digital EMS staff performed a software functional analysis included in Appendix 3. The analysis included a software development plan calling for several key elements to ensure a quality product. These areas are: customer requirements definition, functional requirements definition, testing plan (includes independent verification and validation in a dedicated testing environment), and emergency scenario based testing scripts. Together these elements will provide a foundation to test the Digital EMS software. This document focused on the documenting of DEMS software development including the interagency interactions (policy and procedure) specifications and diagrams.

A final data dictionary has been negotiated with our TAMUS partners. TAMUS has the final implemented data dictionary; however the final proposal from UTHSCH that was used in the negotiation process is attached as Appendix 4. There are 208 main concepts and 587 codes that may be used to fill in the coded concepts. In addition to the data dictionary, UTHSCH has developed a database schema for persistent storage of patient information in an operational system. This schema may also be used for persistent storage at Liberty County EMS. This schema is shown in Appendix 5 attached. The design rationale and goals are best stated by Ms. Vijaya Mekala:

*"Prehospital EMS is a system that ensures that patients with acute traumatic and medical conditions are provided medical care outside the hospital and are transported to an appropriate medical facility. These systems vary in their ability to collect patient and systems data and to put these data to use. To facilitate the proper usage, EMS systems must have methods of collecting and sharing it with others. As with other medical specialties, EMS providers also are required to prove their effect on patient outcome as a justification for their existence. This database is designed in a generic way so that it would not only collect the ambulance and patient information but also connect to the local hospital database, facilitating research efforts, facilitate billing and reimbursement, and providing valuable information on other issues or areas of need related to EMS care. The database can be modified and is scalable according to the needs, constraints, and special considerations of the project. These include, but are not limited to, any preferred software packages, considerations of business rules, time constraints, and overall goals and objectives of the completed software."*

e. *Develop/Evaluate Online Treatment Protocols.* The Liberty County EMS personnel have adopted new medical protocols which necessitated the recoding of portions of existing text-based protocols, as reported in the October 2002 TSR. UTHSCH has reformatted these protocols for display in the Digital EMS systems, and TAMUS has integrated the changes into the software revision currently underway for Liberty County EMS. See Appendix 6.

As was discussed above, SHIS completed the phase I user evaluation study of the Digital EMS software. The new LCEMS software will be evaluated by the SHIS team once the completed treatment protocols are loaded in the IBT medical user test bed. This evaluation is slated to begin during the first quarter of 2003.

f. *Integrate Online Treatment Protocols and Medical Records Information into the Existing System for Enhancing System Functionality.* Integration of the online treatment

protocols and medical records information is still on hold pending the finalization of the data set and information model and the evaluation of the treatment protocols. UTHSCH and TAMUS have had a series of joint task force meetings to address this challenge. The 2 partners are in agreement on the strategic objectives and final goals for integrating treatment protocols and medical records information, but there are still some initial hurdles to be overcome. UTHSCH completed data model and data dictionary studies in the past year. These are included as appendices as referenced above .

*g. Enhance the Existing Infrastructure for Supporting a Network of Multiple Digital EMS Vehicles and Hospital Systems in an Integrated Environment.* UTHSCH has formulated an initial plan for linking Memorial Hermann Hospital (MHH) with private fiber to the IBT facility. UTHSCH has located space within the MHH emergency room area for placement of the doctor's station for the Digital EMS system. UTHSCH has a basic plan for calling the supervising physicians to the Digital EMS workstation to supervise and coordinate care from an in-route rural ambulance.

UTHSCH identified the hardware and met with the MHH decision makers to authorize access to the network in order to create the network link between MHH and the Digital EMS project. As reported previously, significant concerns were brought to our attention by the MHH legal team. With continuing delays to security and privacy as a part of the HIPAA regulations, this goal is taking longer than anticipated to complete. In the next quarter, Dr. James Duke plans to meet with MHH representatives to define the link between the facility and Digital EMS and to further define how the Digital EMS system will work within the MHH network.

In support of this effort, UTHSCH has begun the development of a standardized notification engine to be used to alert the physicians at MHH when a field medic requests assistance. Ms. Mekala and Dr. Matthew Sailors have been drawing up functional requirements for the notification system. As part of this effort, Ms. Mekala has conducted an analysis of the Jabber platform as a potential basis for this system. Her analysis is attached as Appendix 7.

*h. Develop and Test a Prototype Digital EMS Vehicle in Diverse Urban and Rural Settings for Evaluation and Performance Analysis of Integrated Digital Technologies.* UTHSCH and TAMUS staff developed a detailed plan for the deployment in Liberty County, Texas. Plans for a civilian prototype have been finalized and are moving forward at this time. UTHSCH will execute these plans in collaboration with TAMUS during the next quarter of the project.

Work to complete human testing approvals for volunteer subjects was completed and submitted to the USAMRMC IRB at the end of 2002. Consent documentation was finalized between the UTSCHS and TAMUS IRB along with supporting documentation required by USAMRMC. Once approved, volunteer testing in Liberty County will move forward in first quarter 2003. UTHSCH continues to complete the State of Texas community consent requirements leading to approval for human subjects testing without informed consent in the cases of real ambulance trauma runs. Specific waiver of 10 USC 980 will be needed from the Department of the Army Surgeon General to allow this project to follow accepted Texas guidelines.

*i. Evaluation of Life Flight Patient Population to Determine Additional Medical Functionality Needs.* The additional medical functionality added to MHH Life Flight vehicles has not been fully identified. During this project period, UTHSCH personnel met with Life Flight for initial meetings for scope of our project in Life Flight's operations. During the beginning of the next year, the feasibility study is scheduled to begin.

While waiting for the feasibility work to begin, the Digital EMS project looked to a peer's interest in a novel study on pre-hospital data. Entitled "UT-Capture and Analysis of Physiological Data for Prediction of Life Threatening Conditions in Trauma Injuries," and headed by John Holcombe, MD, this work captured all data from the Lifepaq physiological monitor carried on the Life Flight helicopters. Once loaded into the flash memory of a personal data assistant (PDA), a research nurse loaded the patient data into a database without patient identifiers.

A Web-enabled database system went fully online on June 2, 2002 (hosted at <http://traumavitals.tamu.edu>) and currently maintains 600 records including patient history, lifesaving interventions, and vital signs (if available). The trauma vitals team implemented an initial database-querying engine in August 2002, with the ability to query the underlying database for patients based on selection criteria. The system could then export results to a XML file on local machine through a data viewer/editor finalized completed in November 2002. The database also allows for the import and export of XML waveform/numeric information for post processing editing and modification.

This part of the Digital EMS project has been very successful, and has already generated research interests. Currently there is a team of physicians using the retrospective research database for their own studies scheduled for completion in the next year.

*j. Study and Facilitate Integration of Existing Emergency Medical Records Databases.* UTHSCH personnel participated in HL7 meetings in this quarter and focused in part on the application of advanced technology in medical records or hospital database systems. In the changing environments since HIPAA, security and privacy of medical data could not be over emphasized. UTHSCH met with authorities at MHH to plan for the integration of the Digital EMS systems into the existing pre-hospital medical records system. The initial meeting did not resolve many issues related to the access and security of these data. Initially, data will only flow from the Digital EMS systems into the MHH clinical data repository using the same HL7-message-based pathways as other external data sources (such as outside laboratory results). Negotiations to access a constrained, emergency-medicine specific data set are still ongoing.

*k. Develop Methodologies for Using New Local, State, and National Network Infrastructures for Providing the Digital EMS Vehicles with High Speed Terrestrial Connectivity to the Hospital Nodes.* UTHSCH personnel participated in HL7 and AMIA meetings in the past year. Each conference focused in part on the application of advanced technology in medical records or hospital database systems.

The effects of HIPAA security and privacy constraints on these networks are still being considered. UTHSCH plans careful steps related to the medical data in item 11(j) above. This data will ride not only on the local networks at MHH, but also on distributed state and national networks. HIPAA compliance remains a significant challenge, and one that UTHSCH and TAMUS staff continues to address.

*l. Participate in Military Tests, Evaluations, and Exercises.* UTHSCH personnel await notification from USAMRMC for a venue for military testing of the Digital EMS system. UTHSCH plans to participate in the planning and execution of the military tests of the Digital EMS systems and will travel and participate, where possible, as requested by USAMRMC.

UTHSCH is participating an Integrated Product Team (IPT) tasked to establish specifications for a military prototype. The IPT, under the direction of Ms. Cheryl Merritt, USAMRMC, will plan the testing and evaluation of this prototype during the coming year. The

United States Marine Corps expressed the most interest and will probably be the first ones to use a military prototype. The schedule and locations of the exercises are still to be specified, but UTHSCH is ready to fully support the IPT.

*m. Evaluate and Pursue Opportunities to Develop and Implement the Digital EMS System in Disaster Response Scenarios.* UTHSCH personnel, in partnership with TAMUS, will identify opportunities to transfer lessons learned and technologies developed to enhance disaster response and preparedness. With the action of the newly created Defense of Houston group locally, Digital EMS is tracking the issue of disaster preparedness in the local area as well as nationally. This work will continue in the next year.

*n. Publish Findings and Results in Appropriate Conference Proceedings and Journals and Demonstrate Capabilities of the Digital EMS Ambulance.* Publications are listed in the "Reportable Outcomes" section of this report.

*o. Provide Project Progress Reports.* Included in text form in this document.

## KEY RESEARCH ACCOMPLISMENTS

The University of Texas School of Health Information Sciences:

- Performed a comprehensive usability evaluation of Digital EMS Version 1.0.
- Performed a preliminary usability evaluation of Digital EMS Version 2 Mockup
- Performed a task analysis of Digital EMS Version 2 Mockup
- Performed a document analysis of emergency medicine as related to Dreams Project.

UT Digital EMS project staff:

- Leadership in standardizing medical knowledge base representations
- Development of XML schemas for clinical expression language
- Development of local XML standard for representing algorithms (to be used in decision tree versions of DEMS EMT protocols).
- Refinement of LCEMS protocols to remove ambiguity and ready them for decision tree and computer-execution engine (final versions will not be generated until execution engine has been decided on)
- Development of pre-hospital / emergent clinical concepts data dictionary
- Development of information model for representing pre-hospital / ED clinical encounters
- Analysis of Jabber messaging protocol / server for possible use by DEMS.
- Requirements study and development of initial requirements documents for a notifier component.
- Design and preliminary development of critical care nutrition assistant.
- Initial standardization / logic refinement of LCEMS protocols (old protocols)
- Survey documenting state of the science of pre-hospital clinical care algorithms
- Standardization of formatting for LCEMS protocols (new protocols) and translation of LCEMS protocols into form displayable on DEMS computer systems.
- Work on developing XML schema to represent clinical decision support knowledge bases. Based on published ANSI-/ISO-recognized standards.
- Development of generic decision support system message XML schema for consideration by DEMS and Clinical Decision Support Technical Committee (CDSTC) of Health Level Seven, Inc. (HL7) Schema refined from draft proposal submitted to CDSTC in 2000.

The University of Texas Health Science Center at Houston Trauma Vitals Subproject:

Design and implement a system capable of the following:

- Capture a trauma patients critical vital signs from incident pickup until delivery to hospital
- Merge and correlate hospital information and captured data
- Provide a research system for extracting data relationships
- Web accessible to researchers
- Provide a basis for trauma patient injury and research.
- Web enabled database system went fully on line 6/02.
  - <http://traumavitals.tamu.edu>
  - Currently maintains > 500 patients including patient history, life saving interventions, and vital signs (if available).
- Database querying engine implemented 8/02

- Ability to query the underlying database for patients based on selection criteria.
- Export to XML file on local machine
- Data viewer/editor finalized on 11/02
  - Imports/Export XML waveform/numeric information for post processing editing and modification.

Naval Research Laboratory Satellite Development:

- Build Very Small Aperture Terminal (VSAT) - 60 cm antenna, transmit PA = 80 watts.
- DSSS waveform for transmit, conventional narrowband receive.
- Modify tracking hardware and software for ambulance use, which required numerous terminal retrofits due to gyro problems.
- Verify and characterize VSAT operation under motion.
- Motion study started on HMMWV, replicated on ambulance in 2002
- Feedback provided to terminal vendor for improvements in Fall 2002

## REPORTABLE OUTCOMES

### Abstracts and Posters:

Jiajie Zhang, Todd R. Johnson, Zhihua Tang, Elmer Bernstam, Matt Sailors, and Douglas Tindall. Usability evaluation of a digital medical information system. Poster presented at UT Houston 2002 Research Day, Houston, Texas, University of Texas Health Science Center at Houston, November 1, 2002.

Tindall, R. Douglas, Casscells, S. Ward, Sailors, R. Matthew, Bernstam, Elmer V., Galloway, Carolyn S., and Dukes, James H. Saving Lives in Real-Time: A Pre-Hospital Telementoring Case. Poster presented at the American Medical Informatics Association (AMIA) 2002 Symposium, San Antonio, TX, November 11, 2002. See Appendix 7.

Mekala, V. Master of Science in Health Informatics, The University of Texas Health Science Center at Houston, Spring Semester 2002. State of the Science Paper: Computerization Of Clinical Practice Guidelines – A Review On Clinical Care Algorithm.

Sailors, RM: A Proposed Classification Scheme for Multi-Step Clinical Care Algorithms. Journal of the American Medical Informatics Association. 8(Symposium Supplement): 1015, 2001. See Appendix 8.

Sailors, RM: ArdenML: The Arden Syntax Markup Language (or Arden Syntax: It's Not Just Text Any More!). Journal of the American Medical Informatics Association. 8(Symposium Supplement): 1016, 2001. See Appendix 9.

### Conferences:

Participation in the 2002 American Telemedicine Association annual conference help in Los Angeles, California. June 1-6, 2002.

Participation in the 2002 Texas EMS Conference in Austin, Texas. November 24-27, 2002.

## CONCLUSIONS

Work completed in past year:

*Trauma vitals subproject:*

A web enabled database system went fully on line 6/02. (hosted at: <http://traumavitals.tamu.edu>) and currently maintains greater than 600 patients including patient history, life saving interventions, and vital signs (if available). The trauma vitals team implemented an initial database-querying engine in August of 2002 with the ability to query the underlying database for patients based on selection criteria. The system could then export results to a XML file on local machine through a data viewer/editor finalized completed in November 2002. The database also allows for the import and export of XML waveform/numeric information for post processing editing and modification.

This part of the Digital EMS project has been very successful, and has already generated research interests. Currently there is a team of physicians using the retrospective research database for their own studies scheduled for completion in the next year.

*Informatics and data modeling*

During 2002 the UTHSCH informatics team has been heavily involved in the development of XML-based representations of clinical knowledge bases and the elemental expressions (algebraic manipulations) used in these knowledge bases. While many of these representations will remain strictly internal standards, several have been presented to standards development organizations for consideration as formal, open standards. Additional work on standards on standardized decision support system output message formats and notification components has taken place. The informatics team has also developed information models for representing pre-hospital and emergent clinical care encounters and an associated concept data dictionary. The information models and data dictionary<sup>1</sup> have been reconciled with an implementation plan developed by TAMUS.

The clinical protocols that were originally developed by our partner EMS provider have been logically refined and prepared for clinical use as an online reference source. Our EMS provider partner has asked that we provide only this functionality in the initial release of the protocols. Two competing formats for representing these protocols as decision trees have also been developed. An analysis of these formats and comparison with recently published formats has not yet be completed.

Local human subjects approval for healthy, normal volunteers has been obtained from both UTHSCH and TAUMS. Submission for USA approval has occurred.

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<sup>1</sup>A data dictionary is a set of tables that list concept names, definitions, references to standardized terminologies, and where appropriate the enumerated list of values that a concept may hold, e.g. patient sex can be "male" or "female." Data dictionaries DO NOT address how data is organized in any given instantiation, e.g. a database or encrypted table, nor do they explicitly endorse any specific information model; they only bound the content space.

*Digital EMS vehicle procurement:*

During the past year, UTHSCH completed the process for the procurement of two additional Digital EMS vehicles. The digital EMS team issued requests for proposals and quotations were received. The actual contracts for the execution of these orders are still being negotiated, anticipating construction to begin in the first quarter of 2003.

UTHSCH and TAMUS Digital EMS teams are writing testing and training plans for the field-testing of these vehicles in Liberty, Brazos, and Webb counties within Texas. The goal of this testing is to operate the vehicles in remote areas with different terrain environments and with different EMS services. Once this is completed, retrospective study can be done on the research databases built with prehospital patient data.

**Work to be completed in next year:**

*The principal trauma vitals subproject goals for 2003 are:*

- Make sensor inputs more effective.
- Automate data clean up at capture or post processing time – need subject matter expert.
- Miniaturize and increase the ruggedness of data collection system.
- Establish more effective management of large datasets.
- Querying engine for continuous (and semi discreet) data.
- Data mining of real time data.

*The principal informatics and data modeling goals for 2003 are:*

- completion of the decision tree representation of the EMS protocols.
- final adoption of computer-interpretable guideline format(s).
- representation of EMS protocols in computer-interpretable format(s).
- negotiation of a data transfer format and data set with partner hospital.
- adoption / development of computerized decision support system engine.
- continued work with standards development organization to promote DEMS-developed tools and methods as formal standards.
- USA and local IRB approvals to allow use of DEMS with actual patients in communities.

*The principal Digital EMS vehicle procurement and field-testing goals for 2003 are:*

- Completion of the two Digital EMS ambulances.
  - Implement the revised Digital EMS onboard software as developed by TAMUS.
  - Test the new software and hardware with the SHIS evaluation team.
- Train physicians and EMTs on the Digital EMS system in the IBT test bed.
- Support the field-testing of the ambulances in Liberty and subsequent counties.
- Establish the research prehospital database for retrospective study.
- Install and field-test the mobile satellite terminal system developed by the Naval Research Laboratory

## **REFERENCES**

**None.**

## **APPENDICES**

1. SHIS: Usability Engineering of Digital EMS (Version 1.0)  
Part 1 – Heuristic Evaluation
2. SHIS: Usability Engineering of Digital EMS  
Heuristic Evaluation of Version 2 Mockup
3. Software Functional Analysis
4. Data Dictionary
5. Database Schema
6. LCEMS Protocols (reformatted for computer display)
7. Jabber Analysis
8. Saving Lives in Real-Time: A Pre-Hospital Telementoring Case
9. A Proposed Classification Scheme for Multi-Step Clinical Care Algorithms. Journal of the American Medical Informatics Association
10. ArdenML: The Arden Syntax Markup Language (or Arden Syntax: It's Not Just Text Any More!).
11. Curriculum Vitae
  - a. James H. Duke, MD
  - b. Elmer V. Bernstam, MD
  - c. Todd R. Johnson, PhD
  - d. Vijayashree Mekala, MS
  - e. R. Matthew Sailors, PhD
  - f. Ziajie Zhang, PhD

## **APPENDIX 1**

### **Usability Engineering of Digital EMS (Version 1.0)**

#### **Part 1 – Heuristic Evaluation**

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## 0. INTRODUCTION

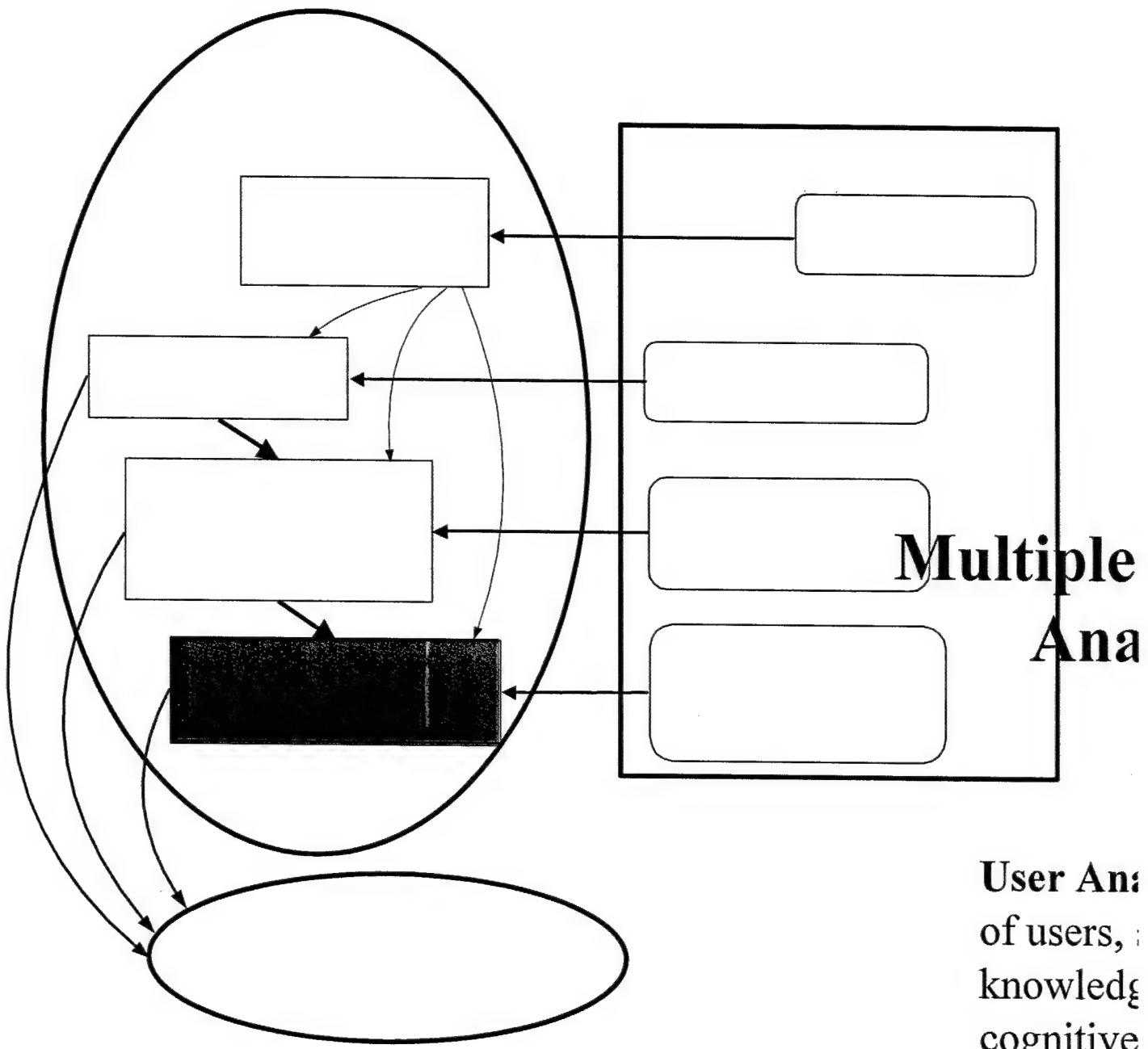
A complete usability engineering project of Digital EMS includes four major components: user, functional, task, and representational analyses (see Figure 0). Heuristic evaluation, which is reported in this document, is at the level of representational analysis and it is one of the major techniques at this level. In this introduction section (Section 0) we briefly introduce these four analyses. In Sections 1, 2, and 3 that follow, we will report the results of a heuristic evaluation of Digital EMS. It should be noted that a heuristic evaluation identifies only potential usability problems in the existing interface. It does not indicate the elements of the system that correctly follow usability guidelines. Nor does it reveal major missing functionality. Other usability engineering techniques at the levels of functional analysis, user analyses can indicate what is right with the system and identify the most appropriate functionality.

User analysis is the process of identifying the characteristics of existing and potential users, such as expertise and skills, knowledge bases, education background, cognitive capacities and limitations, perceptual variations, age related skills, cultural background, personality, time available for learning and training, frequency of system use, etc. User analysis can help us design systems that have the right knowledge and information structure that match that of the users. For a distributed human-computer systems, it is critical to analyze the group properties of users, such as division of cognition and activity, overlap of knowledge and skills, communication channels and styles, social status, and so on.

Functional analysis is the process of identifying critical top-level domain structures, goals, and ideal spaces that are largely independent of implementations. It is more abstract than task and representational analyses because it does not involve details of task processes and representation details.

Task analysis is the process of identifying system functions that have to be performed, procedures and actions to be carried out to achieve task goals, information to be processed, input and output formats that are required, constraints that must be considered, communication needs that have to be satisfied, and the organization and structure as well as the information categories and information flow of the task. One important function of task analysis is to ensure that only the necessary and sufficient task features that match users' capacities and are required by the task will be included in system implementations. Extra fancy features and features that do not match users' capacities or not required by the task will only generate extra processing demands for the user and thus make the system harder to use.

Functional and task analyses are concerned with the functions, structures, and processes of systems. The interface between systems and users is handled by representational analysis. Representational analysis is the process of identifying an appropriate information display format for a given task performed by a specific type of users such that the interaction between users and systems is in a direct interaction mode. With direct interaction interfaces, users can directly, completely, and efficiently engage in the primary tasks they intend to perform, not the housekeeping interface tasks that are barriers between users and systems.



**Figure 0.** A typical usability engineering project involves user, functional, task, and representational analyses. *Heuristic evaluation, which is reported in this document, is at the level of representational analysis and it is one of the major techniques at this level.*

**Functional Analysis:** identify top level domain structure and ideal task space independent of implementation

## 1. EXECUTIVE SUMMARY

The following report gives the results of the heuristic evaluation of Digital EMR Version 1.0. It is important to realize that a heuristic evaluation identifies only potential usability problems in the existing interface. It does not indicate the elements of the system that correctly follow usability guidelines. Nor does it reveal major missing functionality. Other usability engineering techniques, such as functional analysis, user analysis, and task analyses can indicate what is right with the system and identify the most appropriate functionality.

The 14 usability heuristics used for evaluations were violated 161 times (all three workstations combined). Visibility and Consistency are the two heuristics with most violations (48 and 29, respectively). The next one is Match with 22 violations. Note that the Protocol function in Digital EMS has not been thoroughly evaluated in the current study because it is not fully implemented yet.

There are 6 catastrophic violations that received severity ratings over 3.50. It is imperative to fix them. 48 violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. 27 violations are minor violations (between 1.50 and 2.50) that have low priority in fixing. And there is 1 cosmetic problem that needs not be fixed unless extra time is available.

The Paramedic's Station has the largest number of violations (45). Note that this number does not take into account the Protocol function. The numbers of violations identified on the Physician's and Driver's Workstations are 19 and 18, respectively. The average severity ratings of all three workstations are over 2.50, indicating that these are major usability problems that should be fixed with high priority.

For every heuristic violation, we recommended a potential solution. Tables 1.1-1.3 and 2.1-2.3 show the details of the violations and recommended solutions.

## 2. METHODOLOGY

The heuristics evaluation methodology adopted here is a discount usability technique that is used to identify the major usability problems of a product in a timely manner with reasonable cost. This technique requires three or more usability experts to independently apply a set of usability heuristics to a product, identify violations of the heuristics, and assess the severity of each violation.

The three usability experts (evaluators) for the evaluation of Digital EMS are Dr. Jiajie Zhang, Dr. Todd R. Johnson, and Ms. Zhihua Tang. They evaluated the user interface and generated a list of heuristics violations according to the fourteen heuristics described below. This list was given to the three evaluators who then independently accessed the severity of each violation. The ratings from the three evaluators were averaged. The averaged ratings are reported. The next two sections describe the usability heuristics used for Digital EMS and the scale of the severity rating.

## 2.1 Usability Heuristics

The following fourteen heuristics were developed by Jiajie Zhang and Todd R. Johnson. The words in the brackets are the semantic tags for the heuristics.

1. [Consistency] **Consistency and Standards.** Users should not have to wonder whether different words, situations, or actions mean the same thing. Standards and conventions in web design should be followed.
  - a. Sequences of actions (skill acquisition)
  - b. Color (categorization)
  - c. Layout and position (spatial consistency)
  - d. Font, capitalization (levels of organization)
  - e. Terminology (delete, del, remove, rm) and language (words, phrases)
  - f. Standards (e.g., blue underlined text for unvisited hyperlinks)
2. [Visibility] **Visibility of System State.** Users should be always informed what is going on with the system through appropriate feedback and display of information.
  - a. What is the current state of the system?
  - b. What can be done at current state?
  - c. Where can users do?
  - d. What change is made after an action?
3. [Match] **Match between System and World.** The image of the system perceived by users should match the model the users have about the system.
  - a. User model matches system image
  - b. Actions provided by the system should match actions performed by users
  - c. Objects on the system should match objects of the task
4. [Minimalist] **Minimalist.** Any extraneous information is a distraction and a slow-down.
  - a. Less is more
  - b. Simple is not equivalent to abstract and general
  - c. Simple is efficient
  - d. Progressive levels of detail
5. [Memory] **Minimize Memory Load.** Users should not be required to memorize a lot of information to carry out tasks. Memory load reduces users' capacity to carry out the main tasks.
  - a. Recognition vs. recall (e.g., menu vs. commands)
  - b. Externalize information through visualization
  - c. Perceptual procedures
  - d. Hierarchical structure
  - e. Default values
  - f. Concrete examples (DD/MM/YY, e.g., 10/20/99)
  - g. Generic rules and actions (e.g., drag objects)

6. **[Feedback] Informative Feedback.** Users should be given prompt and informative feedback about their actions.
  - a. Direct perception (7 stage model)
  - b. Information that can be directly perceived and interpreted.
  - c. Levels of feedback (novice and expert)
  - d. Concrete and specific, not abstract and general.
  - e. Response time
    - 0.1 second for instantaneously reacting
    - 1.0 second for uninterrupted flow of thought
    - 10 seconds for the limit of attention
7. **[Flexibility] Flexibility and efficiency.** Users always learn and users are always different. Give users the flexibility of creating customization and shortcuts to accelerate their performance.
  - a. Shortcuts for experienced users
  - b. Shortcuts or macros for frequently used operations
  - c. Skill acquisition through chunking
  - d. Examples:
    - Abbreviations, function keys, hot keys, command keys, macros, aliases, templates, type-ahead, bookmarks, hot links, history, default values, etc.
8. **[Message] Good Error Messages.** The messages should be informative enough such that users can understand the nature of errors, learn from errors, and recover from errors.
  - a. Phrased in clear language, avoid obscure codes
    - e.g., “system crashed, error code 147”
  - b. Precise, not vague or general.
    - e.g., “Cannot open document”
  - c. Constructive
  - d. Polite
    - e.g., “illegal user action”, “job aborted”, “system was crashed”, “fatal error”, etc.
9. **[Error] Prevent Errors.** It is always better to design interfaces that prevent errors from happening in the first place.
  - a. Interfaces that make errors impossible.
  - b. Avoid modes (e.g., vi, text wrap,). Or use informative feedback, e.g., different sounds.
  - c. Execution error vs. evaluation error
  - d. Various types of slips.
10. **[Closure] Clear Closure.** Every task has a beginning and an end. Users should be clearly notified about the completion of a task.
  - a. Clear beginning, middle, and end.
  - b. Complete 7-stages of actions.
  - c. Clear feedback to indicate goals are achieved and current stacks of goals can be released.

- e.g., dialogues.

11. **[Undo] Reversible Actions.** Users should be allowed to recover from errors. Reversible actions also encourage exploratory learning.

- a. At different levels: a single action, a subtask, or a complete task
- b. Multiple steps
- c. Encourage exploratory learning
- d. Prevent serious errors

12. **[Language] Use Users' Language.** The language should be always presented in a form understandable by the intended users.

- a. Use standard meanings of words
- b. Specialized language for specialized group
- c. User defined aliases
- d. Users' perspective
  - e.g., "we have bought four tickets for you" vs. "you bought four tickets"

13. **[Control] Users in Control.** Don't give users that impression that they are controlled by the systems.

- a. Users are initiators of actors, not responders to actions.
- b. Avoid surprising actions, unexpected outcomes, tedious sequences of actions, etc.

14. **[Document] Help and Documentation.** Always provide help when needed.

- a. Context-sensitive help
- b. Four types of help
  - task-oriented
  - alphabetically ordered
  - semantically organized
  - search
- c. Help embedded in contents

## 2.2 Severity Rating Scale

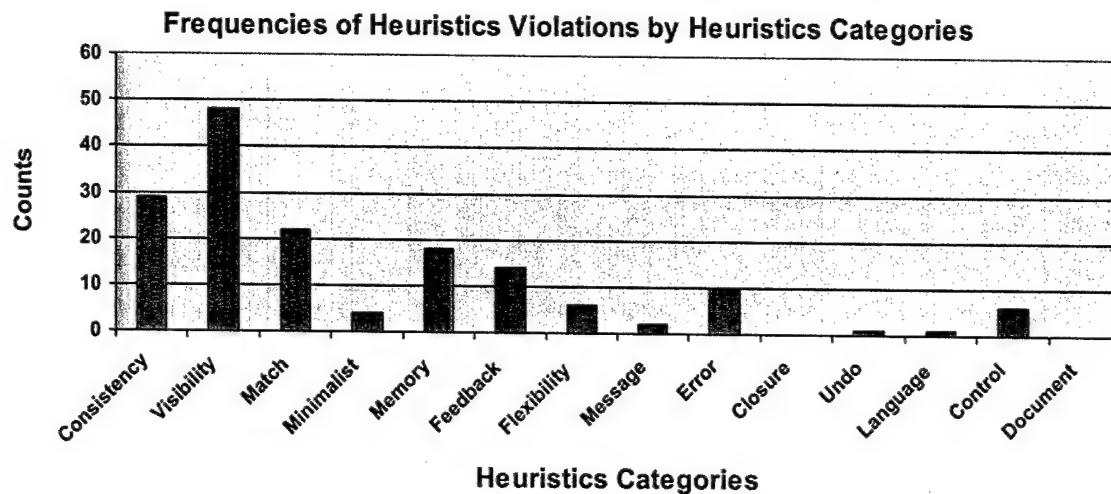
The following scale is used for the assessment of the severity of each heuristic violation.

- 0** = I don't agree that this is a usability problem at all
- 1** = Cosmetic problem only: need not be fixed unless extra time is available on project
- 2** = Minor usability problem: fixing this should be given low priority
- 3** = Major usability problem: important to fix, so should be given high priority
- 4** = Usability catastrophe: imperative to fix this before product can be released

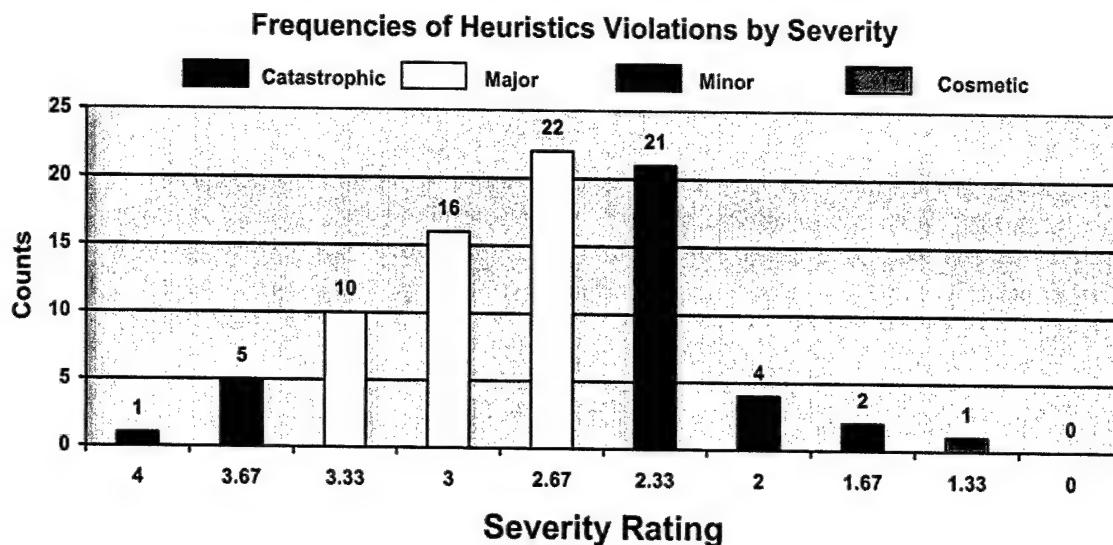
As a guideline for rating the problems, we consider the proportion of users who will experience it, the impact it will have on their experience with the product, and whether the usability problem will be a problem only the first time they encounter it, or whether it will persistently bother them. A persistent problem with a major impact that most users will encounter will get the highest severity rating.

### 3. RESULTS

Figures 1, 2, and 3 show the heuristics violations in Digital EMR along different dimensions. See the figure captions for explanations. Tables 1.1-1.3 show details of the violations ordered by places of occurrences for the Paramedic's Station, Physician Station, and Driver's Station. Tables 2.1-2.3 show them sorted by severity ratings. Potential solutions were recommended for all the violations in the tables.

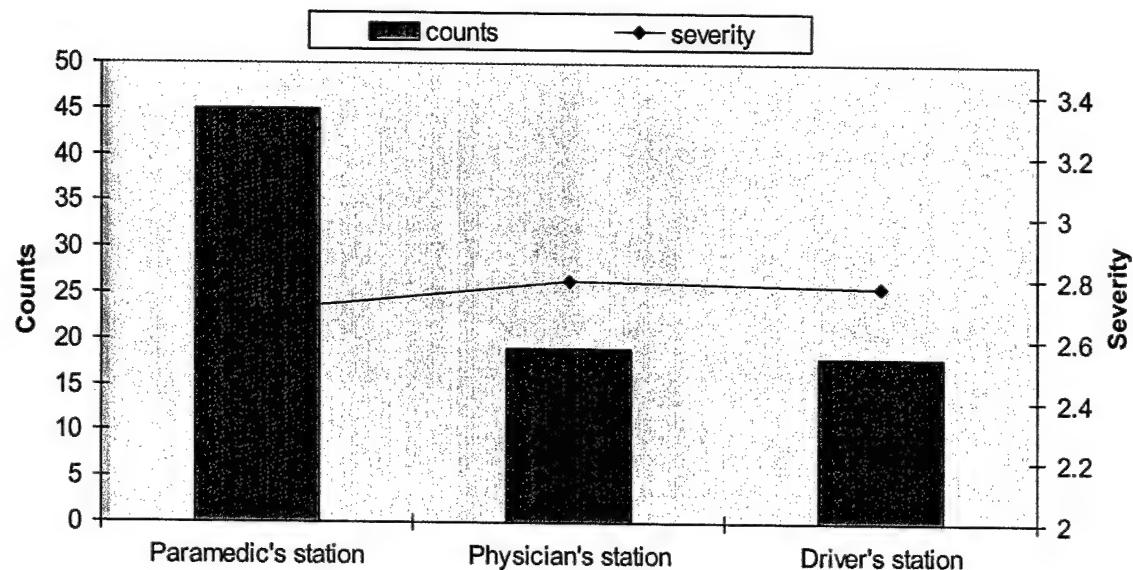


**Figure 1.** The 14 usability heuristics used for evaluations were violated 161 times (all three workstations combined.) Visibility and Consistency are the two heuristics with most violations (48 and 29, respectively). The next one is Match with 22 violations. Note that the Protocol function has not been thoroughly evaluated in the current study because it is not fully implemented.



**Figure 2.** There are 6 catastrophic violations that received severity ratings over 3.50. It is imperative to fix them. 48 violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. 27 violations are minor violations (between 1.50 and 2.50) that have low priority in fixing. And there is 1 cosmetic problem that needs not be fixed unless extra time is available.

### Frequencies and Severity Ratings by Workstation



**Figure 3.** The paramedic's station has the largest number of violations (45). Note that this number does not take into account the protocol function. The numbers of violations identified on the physician's and driver's workstation are 19 and 18, respectively. The average severity ratings of all three workstations are over 2.50, indicating that these are major usability problems that should be fixed with high priority.

**Table 1.1. Heuristics Violations: by Places of Occurrences**

**-- Paramedic's Station**

Function: Section	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
Overall	<p><b>P:</b> Function navigation bar is separated from section tabs within each function. Major functions are located at the bottom of the screen, whereas the tabs on the top of the screen represent lower level sections. This makes it hard to see the connections between the two, and requires constant moving (and looking) up and down during navigation. This problem persisted after we gained experience with the system, indicating that it will not disappear with experience.</p> <p><b>S:</b> Move the function navigation bar to the top, above the section tabs. Use a two-level tab navigation bar at the top.</p>	Visibility Consistency Match Memory Error	3.33
	<p><b>P:</b> Functions “Run Record” and “Report” have a number of sections that require the paramedic’s input. It is not clear at all if clicking button “Save Current Record” (on Run Record: On-Scene) saves all the information or each section needs to be saved separately.</p> <p><b>S:</b> Provide “Save Data” on each data entry page. This button should be in the same place on every page. A more systematic solution is to create a drop-down menu that contains all the major functions common for all sections, such as the “File” menu on all Microsoft products. d.</p>	Visibility Memory Consistency Feedback	3.67
	<p><b>P:</b> There is no visible indication of whether data needs to be saved or whether it has been saved.</p> <p><b>S:</b> If the system does not automatically save after every entry, provide a salient indication on every screen that a save is required. One way to do this is by activating and visually highlighting the Save button anytime a save is required. If the system autosaves only when a user switches to a different page, you must still provide some visible indicator on each page to let the user know that the data has (or has not) been saved; otherwise, the user will not know whether or not the data has been autosaved.</p>	Visibility Feedback	3.33
	<p><b>P:</b> Pull-down menus in data entry sections also allow the paramedic to type in information manually, but the arrow buttons give the impression that one can only select from the menu.</p>	Visibility Consistency	2.33

	<b>S:</b> Emphasize this in training; Set default for pull-down menus as “type or select”.		
Run Record: On-Scene	<b>P:</b> Buttons “Create New Record” and “Save Current Record” are inconsistent with the rest of the buttons and are difficult to see. <b>S:</b> Use a consistent button design. Place “create new record” and “save current record” at the top of the page, separated from the data fields. Consider adding a menu bar containing one or more menus at the top for common and frequent tasks.	Consistency Visibility Match Consistency	2.33
	<b>P:</b> Patient’s name, currently at the bottom, is difficult to see, both because of its font size and of its location. <b>S:</b> Display patient’s name in a more prominent location (on top, near the section tabs) and in a bigger font.	Visibility	3
	<b>P:</b> If no patient’s name is entered, name field only displays “.” <b>S:</b> The system should designate a default value (e.g., patient #1) for patients whose name is not accessible.	Memory Visibility	2.67
	<b>P:</b> Create new record does not update the patient’s name at the bottom. <b>S:</b> default to “New Patient.”	Consistency Visibility Feedback	2.67
	<b>P:</b> Modifying the first or last name creates a completely new record. <b>S:</b> Provide feedback (e.g., display a message) prior to automatically generating a new record. This should be associated with the “save” function. Use “save” to save to current file and “save as” to save to a new file. Again, the current “save” function needs to be redesigned.	Consistency Feedback Error Match	3.67
	<b>P:</b> No feedback once “Save Current Record” is clicked. <b>S:</b> Provide explicit feedback (e.g., change the cursor, or display a message.) Or completely redesign the “save” function such as move it to a top menu.	Feedback	3.33
	<b>P:</b> If a 2nd record arrives (a new ID is scanned in,) the 1st record is gone without warning the user. And there is no indication of whether the old is saved or not saved. <b>S:</b> Provide explicit feedback (e.g., display a message.)	Error Visibility Undo	3.67
	<b>P:</b> No suggestion on re-saving record once data in a section is modified. <b>S:</b> If information in a section is changed, before the paramedic switches to another function (section), display a message as a reminder.	Visibility	3
	<b>P:</b> In the vehicle pop-up menu, if the mouse is on the	Bug	2.33

	top half of the arrow button when it is clicked, the menu won't stay (hitting "van"); if on the bottom half, then the menu stays; <b>S:</b> Use radio buttons or small graphics to display options, instead of the pop-up menu..	Match Visibility	
	<b>P:</b> Scan ID in to create a new record. Once you click on the arrow, the record is gone. <b>S:</b> fix the bug	bug	4
Run Record: Exam/Obser- vation	<b>P:</b> No way to change the image (gender of the patient) from this page, the user must return to the page containing demographic data. <b>S:</b> Set up two radio buttons above the image to allow the paramedic to change the gender.	Control Flexibility	2
	<b>P:</b> The question mark besides the Glasgow scale is not clear in terms of its meaning. It should also be put inside the boundary box surrounding the Glasgow scale. <b>S:</b> Label the "?" button in text.	Visibility Memory	2.33
	<b>P:</b> Pull-down menu for consciousness does not cover the full range of consciousness. <b>S:</b> Add more options to make the list complete.	Match	2.67
	<b>P:</b> The Left, Right Pupil pull-down menus also allow type-in but each has only two choices. <b>S:</b> If there are only two choices, it is better to implement as radio buttons or at least not allow type-in.	Visibility Minimalism	2.33
	You can have only one number on the body image, but it allows you to add more symptom items (Note: this may not be a usability problem at all if it is ok for the paramedic to enter symptoms here without specifying where they are on the body image.) No connections between the numbers and the GUI widgets.	Match	1.33
Run Record: Patient HX	<b>P:</b> What happens if one is allergic to more than one item in a category (how is the information entered?) <b>S:</b> Display all allergies in each category and allow the paramedic to check all that applies; Or ask the paramedic to type in the fields.	Match Flexibility	2.33
Run Record: Patient TX	<b>P:</b> Medication and dosage/route are not linked (The latter two are not sensitive to the value in the medication slot.) <b>S:</b> Make the options for Dosage and Route contingent upon input in the Medicine slot.	Consistency Error	2.67
	<b>P:</b> No indication of the format of the time. <b>S:</b> Specify the format of the time by giving an example, e.g., 18:45	Memory Match	2.67

	<p><b>P:</b> The function of the set button following time is not clear at all. No feedback after it is clicked. What happens if it is not clicked? Does it have to be clicked for something to happen? Can time still be changed after "set" is clicked? <b>S:</b> Remove it if is redundant.</p>	Memory Feedback Visibility	3.33
	<p><b>P:</b> "Responses to TX" is separate from the medication (listed above.) There could be a number of medications but there is only one response slot. <b>S:</b> ?</p>	Match	2
Run Record: Narrative	<p><b>P:</b> The function of this section is not very clear. <b>S:</b> If both the paramedic and the physician can provide input here, it needs to have two separate fields for each party for synchronization purpose.</p>	Match	3
Video/Vital	<p><b>P:</b> Patient's name is not displayed. What happens if there is more than one patient on board? <b>S:</b> Display patient's name in a prominent location (same as with the Run Record function.)</p>	Visibility Match Memory	3.33
Protocols	<p><b>P:</b> Lots of problems. It needs to be completely redesigned. Just a few examples of design problems,</p> <ol style="list-style-type: none"> <li>1. Structure of the screen protocols appears to be hierarchical (title with six types,) but in fact they are parallel;</li> <li>2. Cursor doesn't change on html links;</li> <li>3. When deep in the structure, no indication of the level;</li> <li>4. On certain pages, there is an invisible but functional "back" button.</li> </ol> <p><b>S:</b> This section needs to be <i>completely</i> re-designed to conform to web design standards. For example,</p> <ol style="list-style-type: none"> <li>1. The first screen should be called "index" page;</li> <li>2. Always provide a back button on each page.</li> </ol>	Visibility Consistency Memory Match	3.67
Map	<p><b>P:</b> Address fields on the top allow selection by mouse and appear to be editable, but the user is not allowed to edit them. <b>S:</b> Display the information as pure text, not as a text box field.</p>	Consistency Visibility	2.33
	<p><b>P:</b> On the right panel, Destination, TBD, and Range are actually pull-down menus but it is impossible to see this because of low contrast (Background of the menus is same as that for the whole screen display.) <b>S:</b> Change their background to increase visibility.</p>	Visibility	3
	<p><b>P:</b> The middle button of the keypad has two modes (GPS and scroll.) Exactly what does each mode mean? Also in scroll mode, clicking on an arrow causes the mid button to automatically switch to GPS.</p>	Visibility Memory Bug	3.33

	<b>S:</b> The middle button should not be used as a mode button.		
Comms	<b>P:</b> All the options are not clickable. Besides, the option button is under ICM but all the rest are located above their respective channels. <b>S:</b> If options do not serve any function, remove them.	Consistency Visibility	2.67
	<b>P:</b> On and Off look like radio-buttons, giving the false impression that they are clickable. <b>S:</b> If this information is redundant with Throughput, consider removing it completely.	Consistency Visibility	2.33
	<b>P:</b> Bandwidth is displayed in numbers. It could be a bit too complicated for paramedics. <b>S:</b> Could be better implemented as graphs.	Consistency Match	1.67
Report	<b>P:</b> Once you click on “report”, the last section in the previous “report” session is the default. There is no absolute default page (even across patients.) <b>S:</b> Set a default section.		2
	<b>P:</b> The text entered for one patient is displayed for every patient once the patient name is switched. (Is it saved? Don’t know.) <b>S:</b> fix the bug	bug	4
Report: Vitals Report	<b>P:</b> Incident does not tell what should be reported; Date: no format indicated; Dispatch (Time): no format indicated; when impossible data are entered, the system gives no error message. It is not clear what the two “set” buttons mean? Once clicked, time is still editable. <b>S:</b> use examples to show the format. Reconsider the “set” buttons.	Error Visibility Memory	3
	<b>P:</b> Can’t switch to another patient on this page though it seems to allow this. <b>S:</b> either remove the patient selection drop-down menu to disallow the switching of patient or make it switch-able.	Flexibility Visibility	3
Report: Billing	<b>P:</b> Patient name and address should be consistent with the information obtained in other sections. <b>S:</b> Automatically fill in the slots from input in other sections.	Minimalist Consistency Error	3.33
	<b>P:</b> Bill To: options as buttons <b>S:</b> use radio buttons instead of buttons.	Consistency Visibility	2.67
	<b>P:</b> Options for relationships are not complete. <b>S:</b> Should include more choices.	Match	2.33
	<b>P:</b> Zip code slot and tel # slot allow for text as input. <b>S:</b> These two slots should allow only numbers.	Error	2.33
Report: Release:	<b>P:</b> Date slots are not constrained, and format is not specified	Error	2.33

	<b>S:</b> This slot should only allow number input and format should be indicated		
	<b>P:</b> No way to input signature. <b>S:</b> Should this page be printed out and have patients sign on paper?	Match	1.67
Report: Transport/Crew	<b>P:</b> Patient transported to slot should read directly from map information. <b>S:</b> Automatically fill in the slots from input in other sections.	Minimalist Memory	2.33
Report: Report	<b>P:</b> Ambiguous section meaning. Also print to a printer in the ambulance or in the hospital? <b>S:</b> Section should be labeled "Print". Also should separate "Print" from "Report". This can be done by adding a menu bar that includes save, save as, print, exit, etc.	Consistency Match	2.67
	<b>P:</b> First 5 items are from Run Record, the last 4 are from Report. <b>S:</b> Should provide separation between these two categories.	Consistency Visibility	2.33
	<b>P:</b> What if there is more than one patient? In Run record, one can easily choose a patient. In Report, one can't do this. The patient is set to whoever is selected in run record. <b>S:</b> either allow switching between patients here or disallow it by not showing the drop-down button.	Flexibility Visibility	2.67
	<b>P:</b> Once a record is created, everything from the previous report is copied. <b>S:</b> fix the bug	bug	4

**Table 1.2. Heuristics Violations: by Places of Occurrences**

**– Physician’s Station**

<b>Function: Section</b>	<b>Problem Description (P) Recommended Solution (S)</b>	<b>Heuristics Violated</b>	<b>Severity Rating</b>
Overall	<p><b>P:</b> No indication as to which EMS (of multiple ones) the current record is from.</p> <p><b>S:</b> Display the AmbID/patient’s name on <b>EACH</b> function/section page, and at a prominent location.</p>	Memory Visibility Error	4
	<p><b>P:</b> How does the physician know how to divide his or her time among different ambulances/patients? The patient list does not provide information for the physician to determine priority.</p> <p><b>S:</b> more information should be provided such that the ER physicians can make informed decisions.</p>	Memory	3.33
	<p><b>P:</b> All sections within “Run Record” are much the same as on the paramedic’s station. However, the normal text fields and pull-down menus (though deactivated) give rise to the false impression that the physician can change the data. There is no indication that they will never be active.</p> <p><b>S:</b> If the data are never editable, display them in pure text instead of in text box fields. If the controls/buttons can never be used, remove them from the screen.. If the controls may sometimes be used, find a way to make these items look inactive and make sure the users know how to activate them.</p>	Match Consistency Visibility	2.67
Run Record: On-Scene	<p><b>P:</b> Message displayed beside the vehicle is inconsistent with the actual action allowed (the physician should not set anything for the vehicle involved.)</p> <p><b>S:</b> Take away the message and the arrow button to the right of the vehicle image.</p>	Message Consistency Visibility	2.33
	<p><b>P:</b> The “Refresh Records” button (a function button) is embedded in the patient’s data and hard to see. Also clicking this button gives no feedback.</p> <p><b>S:</b> Move this button to a more prominent location (at the top, near the section tabs.) Provide visual feedback (change the cursor or display a message) when the physician clicks this button. Or integrate it into a top menu bar with other major functions such as “save”.</p>	Visibility Feedback	3
Videos	<p><b>P:</b> AmbID is a pull-down menu but is hard to see because of low contrast; the patient’s name is not shown here.</p> <p><b>S:</b> Change the background of the pull-down menu to</p>	Consistency visibility	3

	increase visibility; Move this pull-down to a more prominent location (top left corner;) Display patient's name along with AmbID.		
	<b>P:</b> Both of the upper two other cameras are actually menus but look just like text fields. <b>S:</b> Change the background of the pull-down menus to increase visibility.	Consistency Visibility	2.33
	<b>P:</b> Orientation of the human figure is incongruent with the spatial orientation of the video image. <b>S:</b> Align the human figure with video image.	Match	2.33
	<b>P:</b> Numbers for the preset are clickable but look like text, not clickable buttons. Once clicked, the feedback (the number becomes red) is too small. <b>S:</b> The two should be combined into one clickable icon.	Visibility	2.67
	<b>P:</b> Preset cam #1 does not work, 2 and 3 are working <b>S:</b> fix the bug	bug	4
	<b>P:</b> The preset is patient-centered while the zoom control is physician-centered. <b>S:</b> Pick either one but not both	Match	2
	<b>P:</b> The zoom controls do not provide sufficient feedback. For example, when the physician clicks a zoom button, the system gives no indication about the zoom level. Even when the camera is already zoomed in or out, the buttons are still clickable. Also, The meaning of “-” and “+” signs appear to be arbitrary. <b>S:</b> Display several zoom levels on a zoom bar and allow the physician to randomly pick one at any time. Make this control similar to the one used on the drivers map.	Visibility Feedback Error	3.33
	<b>P:</b> If cam1 is on, the physician should have no control but the controls are still activated and clickable. <b>S:</b> De-activate camera controls and make sure they are visually deactivated.	Visibility Match	2.67
	<b>P:</b> Once an area of interest is selected, if the physician left clicks the mouse, the red boundary disappears (but the area is still there.) To take away the area, one has to right click the mouse. <b>S:</b> Action should be done by left-click. Right click is for selection	Consistency	3.33
	<b>P:</b> The small and big video windows are out of sync. Changes do not happen at the same time. The big video window changes first. <b>S:</b> fix the bug	Bug?	3
	<b>P:</b> The two other cameras do not have thumbnail images as the other three.	Consistency	2.33

	<b>S:</b> Provide consistent thumbnails for all cams		
Vitals	<b>P:</b> On the middle panel, the “X” button’s function is hard to determine. <b>S:</b> Label this button in text.	Visibility	3
	<b>P:</b> On “Auto BP control” panel, one needs to go through two steps to set interval (first click a number and then click “set interval”), and once the interval is set, there is no visual feedback as to which one is now in effect. <b>S:</b> Merge the two steps into one (clicking a number sets the interval.) The number remains depressed to indicate the current BP interval.	Minimalist Feedback	2.67
	<b>P:</b> Will “Update BP Now” overwrite the automatic BP setting? How does it proceed (does the paramedic need to get the BP or does it get from the paramedic’s data automatically?) <b>S:</b> the buttons should be redesigned to avoid the ambiguity.	Visibility Match Memory	3
	Did not find “pause” “unpause” buttons.		
Map	<b>P:</b> Drop-down menus for Range and Ambulance appear to be text fields <b>S:</b> Change background of the pull-down menus; make the down arrow visible.	Visibility Consistency	2.67
	<b>P:</b> The middle button on the map control panel (among the navigation arrow buttons) has two modes “Center” and “scroll,” but they are not readily visible. <b>S:</b> The middle button should not be used as a mode button. Same as on the paramedic’s workstation.	Visibility	2.33

**Table 1.3. Heuristics Violations: by Places of Occurrences**

**— Driver's Station**

<b>Function: Section</b>	<b>Problem Description (P) Recommended Solution (S)</b>	<b>Heuristics Violated</b>	<b>Severity Rating</b>
Overall	<b>P:</b> Top address fields look like they are editable but they are actually not. <b>S:</b> Display the information in text instead of as text fields.	Visibility Consistency	2.33
Select Feature	<b>P:</b> Icons are hard to recognize because of low contrast. <b>S:</b> Increase contrast.	Visibility	3
	<b>P:</b> Most icons do not appear to correspond to standard symbology and may therefore be difficult to understand. <b>S:</b> Improve icon design by using standard icons or designing more intuitive icons.	Consistency	2.67
	<b>P:</b> “Exit” is ambiguous since it is also commonly used in computer dialogue, meaning to close the current window or application. <b>S:</b> Change to “Road Exit”.	Message	2.33
Street Address:	<b>P:</b> No default value for town/city. <b>S:</b> Should default to the town/city in which the EMS is located.	Flexibility Memory	2.67
Edit street map	<b>P:</b> Radio buttons are used as action buttons. <b>S:</b> Use buttons instead of radio buttons.	Consistency	3
Reference	<b>P:</b> Reference points are labeled as No.1, No.2, etc. There is no indication as to what a reference point represents. Once No. 1 is removed, the original No. 2 becomes No. 1. <b>S:</b> Allow a user to label reference points. Don't change the numbers when a point is deleted.	Memory Consistency	3
	<b>P:</b> Zoom control is far away from Map Display control panel. <b>S:</b> Put the two next to each other.	visibility	2
Track Ambulance	<b>P:</b> Once a user initiates “Track Ambulance”, the system provides no indication about the current mode. <b>S:</b> Keep the “Track Ambulance” button depressed, or display a text message on the map. Consider a checkbox next to track ambulance: if checked the ambulance is being tracked, otherwise it is not.	Feedback Memory Visibility	3
	<b>P:</b> Once a user initiates “calculating route”, there is no way to cancel it, though the button is there. Calculating route can take a long time (more than a minute), giving users an impression that the process might be dead.	Control Feedback	3.67

	<b>S:</b> Provide a way to cancel this process and show its progress		
	<b>P:</b> Once a user selects “mark destination”, there is no feedback on the map. <b>S:</b> Mousepointer should change to indicate the mode.	Visibility Feedback	2.67
	<b>P:</b> On the Map Display control panel, N, S, W, E are also clickable but they do not look like they are. <b>S:</b> Add arrows on these buttons and put N, S, W, E outside the buttons.	Visibility	2
Hide route:	<b>P:</b> There is no feedback to show that the route is there but hidden. <b>S:</b> Design a complimentary “Show Route” button which is only active when a route is available, but has been hidden.	Feedback Visibility	2.67
On the map	<b>P:</b> There is no way to find out what an icon means. <b>S:</b> Once the mouse is pointed to an icon, display a tooltip to tell what it represents.	Memory	2.33
	<b>P:</b> The map is not directly manipulable. No way to directly click on the map to give the address input. <b>S:</b> make the objects on the map manipulable.	control	2.67
	<b>P:</b> To mark the destination, one has to click just on the line for a road. The system doesn't accept a slightly off-line click. <b>S:</b> Make it more flexible while accepting a mouse click as the input.	Flexibility	3
	<b>P:</b> Can't re-open a street or remove a landmark directly on the map. <b>S:</b> Allow these operations directly on the map.	control	2
	<b>P:</b> When removing a landmark, the button says “set” <b>S:</b> Label the button “Remove”.	Consistency language	2.67
	<b>P:</b> Once a mode is selected, the mouse pointer doesn't change to indicate the mode one is in. <b>S:</b> Provide feedback by changing the mouse pointer. Without a mouse pointer (such as with the touch screen), provide an onscreen visual indication of the mode the system is in.	Feedback Visibility	2.67
	<b>P:</b> Once calculating a route, the user can't do anything before clicking “clear route”. <b>S:</b> Add a “cancel” button	Control Visibility	3
	<b>P:</b> No heads-up orientation of the map. <b>S:</b> Consider providing such a function as this may be the most useful display for the driver	Match	2.33
	<b>P:</b> When putting in destination, “street destination” is highlighted. Click again, the system removes the route and leaves the fields empty. <b>S:</b> fix the bug	Bug?	3.5

	<b>P:</b> The system crashed when the address did not match the zip code. <b>S:</b> fix the bug	Bug?	4
	<b>P:</b> How does one go back to no-route (to remove the route) other than initiate “new route”? <b>S:</b> provide such an option	Control	2.5
	System response is too slow.		4

**Table 2.1. Heuristics Violations: Sorted by Severity Ratings**

— Paramedic's Station

Function: Section	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
Run Record: On-Scene	<b>P:</b> Scan ID in to create a new record. Once you click on the arrow, the record is gone. <b>S:</b> fix the bug	bug	4
Report	<b>P:</b> The text entered for one patient is displayed for every patient once the patient name is switched. (Is it saved? Don't know.) <b>S:</b> fix the bug	bug	4
Report: Report	<b>P:</b> Once a record is created, everything from the previous report is copied. <b>S:</b> fix the bug	bug	4
Overall	<b>P:</b> Functions "Run Record" and "Report" have a number of sections that require the paramedic's input. It is not clear at all if clicking button "Save Current Record" (on Run Record: On-Scene) saves all the information or each section needs to be saved separately. <b>S:</b> Provide "Save Data" on each data entry page. This button should be in the same place on every page. A more systematic solution is to create a drop-down menu that contains all the major functions common for all sections, such as the "File" menu on all Microsoft products. d.	Visibility Memory Consistency Feedback	3.67
Run Record: On-Scene	<b>P:</b> Modifying the first or last name creates a completely new record. <b>S:</b> Provide feedback (e.g., display a message) prior to automatically generating a new record. This should be associated with the "save" function. Use "save" to save to current file and "save as" to save to a new file. Again, the current "save" function needs to be redesigned.	Consistency Feedback Error Match	3.67
Run Record: On-Scene	<b>P:</b> If a 2nd record arrives (a new ID is scanned in,) the 1st record is gone without warning the user. And there is no indication of whether the old is saved or not saved. <b>S:</b> Provide explicit feedback (e.g., display a message.)	Error Visibility Undo	3.67
Protocols	<b>P:</b> Lots of problems. It needs to be completely redesigned. Just a few examples of design problems, 1. Structure of the screen protocols appears to be hierarchical (title with six types,) but in fact they are parallel;	Visibility Consistency Memory Match	3.67

	<p>2. Cursor doesn't change on html links;</p> <p>3. When deep in the structure, no indication of the level;</p> <p>4. On certain pages, there is an invisible but functional "back" button.</p> <p><b>S:</b> This section needs to be <i>completely</i> re-designed to conform to web design standards. For example,</p> <ol style="list-style-type: none"> <li>1. The first screen should be called "index" page;</li> <li>2. Always provide a back button on each page.</li> </ol>		
Overall	<p><b>P:</b> Function navigation bar is separated from section tabs within each function. Major functions are located at the bottom of the screen, whereas the tabs on the top of the screen represent lower level sections. This makes it hard to see the connections between the two, and requires constant moving (and looking) up and down during navigation. This problem persisted after we gained experience with the system, indicating that it will not disappear with experience.</p> <p><b>S:</b> Move the function navigation bar to the top, above the section tabs. Use a two-level tab navigation bar at the top.</p>	Visibility Consistency Match Memory Error	3.33
Overall	<p><b>P:</b> There is no visible indication of whether data needs to be saved or whether it has been saved.</p> <p><b>S:</b> If the system does not automatically save after every entry, provide a salient indication on every screen that a save is required. One way to do this is by activating and visually highlighting the Save button anytime a save is required. If the system autosaves only when a user switches to a different page, you must still provide some visible indicator on each page to let the user know that the data has (or has not) been saved; otherwise, the user will not know whether or not the data has been autosaved.</p>	Visibility Feedback	3.33
Run Record: On-Scene	<p><b>P:</b> No feedback once "Save Current Record" is clicked.</p> <p><b>S:</b> Provide explicit feedback (e.g., change the cursor, or display a message.) Or completely redesign the "save" function such as move it to a top menu.</p>	Feedback	3.33
Run Record: Patient TX	<p><b>P:</b> The function of the set button following time is not clear at all. No feedback after it is clicked. What happens if it is not clicked? Does it have to be clicked for something to happen? Can time still be changed after "set" is clicked?</p> <p><b>S:</b> Remove it if is redundant.</p>	Memory Feedback Visibility	3.33
Video/Vital	<p><b>P:</b> Patient's name is not displayed. What happens if there is more than one patient on board?</p>	Visibility Match	3.33

	<b>S:</b> Display patient's name in a prominent location (same as with the Run Record function.)	Memory	
Map	<b>P:</b> The middle button of the keypad has two modes (GPS and scroll.) Exactly what does each mode mean? Also in scroll mode, clicking on an arrow causes the mid button to automatically switch to GPS. <b>S:</b> The middle button should not be used as a mode button.	Visibility Memory Bug	3.33
Report: Billing	<b>P:</b> Patient name and address should be consistent with the information obtained in other sections. <b>S:</b> Automatically fill in the slots from input in other sections.	Minimalist Consistency Error	3.33
Run Record: On-Scene	<b>P:</b> Patient's name, currently at the bottom, is difficult to see, both because of its font size and of its location. <b>S:</b> Display patient's name in a more prominent location (on top, near the section tabs) and in a bigger font.	Visibility	3
Run Record: On-Scene	<b>P:</b> No suggestion on re-saving record once data in a section is modified. <b>S:</b> If information in a section is changed, before the paramedic switches to another function (section), display a message as a reminder.	Visibility	3
Run Record: Narrative	<b>P:</b> The function of this section is not very clear. <b>S:</b> If both the paramedic and the physician can provide input here, it needs to have two separate fields for each party for synchronization purpose.	Match	3
Map	<b>P:</b> On the right panel, Destination, TBD, and Range are actually pull-down menus but it is impossible to see this because of low contrast (Background of the menus is same as that for the whole screen display.) <b>S:</b> Change their background to increase visibility.	Visibility	3
Report: Vitals Report	<b>P:</b> Incident does not tell what should be reported; Date: no format indicated; Dispatch (Time): no format indicated; when impossible data are entered, the system gives no error message. It is not clear what the two "set" buttons mean? Once clicked, time is still editable. <b>S:</b> use examples to show the format. Reconsider the "set" buttons.	Error Visibility Memory	3
Report: Vitals Report	<b>P:</b> Can't switch to another patient on this page though it seems to allow this. <b>S:</b> either remove the patient selection drop-down menu to disallow the switching of patient or make it switch-able.	Flexibility Visibility	3
Run Record: On-Scene	<b>P:</b> If no patient's name is entered, name field only displays ","	Memory Visibility	2.67

	<b>S:</b> The system should designate a default value (e.g., patient #1) for patients whose name is not accessible.		
Run Record: On-Scene	<b>P:</b> Create new record does not update the patient's name at the bottom. <b>S:</b> default to "New Patient."	Consistency Visibility Feedback	2.67
Run Record: Exam/Observation	<b>P:</b> Pull-down menu for consciousness does not cover the full range of consciousness. <b>S:</b> Add more options to make the list complete.	Match	2.67
Run Record: Patient TX	<b>P:</b> Medication and dosage/route are not linked (The latter two are not sensitive to the value in the medication slot.) <b>S:</b> Make the options for Dosage and Route contingent upon input in the Medicine slot.	Consistency Error	2.67
Run Record: Patient TX	<b>P:</b> No indication of the format of the time. <b>S:</b> Specify the format of the time by giving an example, e.g., 18:45	Memory Match	2.67
Comms	<b>P:</b> All the options are not clickable. Besides, the option button is under ICM but all the rest are located above their respective channels. <b>S:</b> If options do not serve any function, remove them.	Consistency Visibility	2.67
Report: Billing	<b>P:</b> Bill To: options as buttons <b>S:</b> use radio buttons instead of buttons.	Consistency Visibility	2.67
Report: Report	<b>P:</b> Ambiguous section meaning. Also print to a printer in the ambulance or in the hospital? <b>S:</b> Section should be labeled "Print". Also should separate "Print" from "Report". This can be done by adding a menu bar that includes save, save as, print, exit, etc.	Consistency Match	2.67
Report: Report	<b>P:</b> What if there is more than one patient? In Run record, one can easily choose a patient. In Report, one can't do this. The patient is set to whoever is selected in run record. <b>S:</b> either allow switching between patients here or disallow it by not showing the drop-down button.	Flexibility Visibility	2.67
Overall	<b>P:</b> Pull-down menus in data entry sections also allow the paramedic to type in information manually, but the arrow buttons give the impression that one can only select from the menu. <b>S:</b> Emphasize this in training; Set default for pull-down menus as "type or select".	Visibility Consistency	2.33
Run Record: On-Scene	<b>P:</b> Buttons "Create New Record" and "Save Current Record" are inconsistent with the rest of the buttons and are difficult to see. <b>S:</b> Use a consistent button design. Place "create new record" and "save current record" at the top of the page, separated from the data fields. Consider adding	Consistency Visibility Match Consistency	2.33

	a menu bar containing one or more menus at the top for common and frequent tasks.		
Run Record: On-Scene	<p><b>P:</b> In the vehicle pop-up menu, if the mouse is on the top half of the arrow button when it is clicked, the menu won't stay (hitting "van"); if on the bottom half, then the menu stays;</p> <p><b>S:</b> Use radio buttons or small graphics to display options, instead of the pop-up menu..</p>	Bug Match Visibility	2.33
Run Record: Exam/Obser- vation	<p><b>P:</b> The question mark besides the Glasgow scale is not clear in terms of its meaning. It should also be put inside the boundary box surrounding the Glasgow scale.</p> <p><b>S:</b> Label the "?" button in text.</p>	Visibility Memory	2.33
Run Record: Exam/Obser- vation	<p><b>P:</b> The Left, Right Pupil pull-down menus also allow type-in but each has only two choices.</p> <p><b>S:</b> If there are only two choices, it is better to implement as radio buttons or at least not allow type-in.</p>	Visibility Minimalism	2.33
Run Record: Patient HX	<p><b>P:</b> What happens if one is allergic to more than one item in a category (how is the information entered?)</p> <p><b>S:</b> Display all allergies in each category and allow the paramedic to check all that applies; Or ask the paramedic to type in the fields.</p>	Match Flexibility	2.33
Map	<p><b>P:</b> Address fields on the top allow selection by mouse and appear to be editable, but the user is not allowed to edit them.</p> <p><b>S:</b> Display the information as pure text, not as a text box field.</p>	Consistency Visibility	2.33
Comms	<p><b>P:</b> On and Off look like radio-buttons, giving the false impression that they are clickable.</p> <p><b>S:</b> If this information is redundant with Throughput, consider removing it completely.</p>	Consistency Visibility	2.33
Report: Billing	<p><b>P:</b> Options for relationships are not complete.</p> <p><b>S:</b> Should include more choices.</p>	Match	2.33
Report: Billing	<p><b>P:</b> Zip code slot and tel # slot allow for text as input.</p> <p><b>S:</b> These two slots should allow only numbers.</p>	Error	2.33
Report: Release:	<p><b>P:</b> Date slots are not constrained, and format is not specified</p> <p><b>S:</b> This slot should only allow number input and format should be indicated</p>	Error	2.33
Report: Transport/C- rew	<p><b>P:</b> Patient transported to slot should read directly from map information.</p> <p><b>S:</b> Automatically fill in the slots from input in other sections.</p>	Minimalist Memory	2.33
Report: Report	<p><b>P:</b> First 5 items are from Run Record, the last 4 are from Report.</p>	Consistency Visibility	2.33

	<b>S:</b> Should provide separation between these two categories.		
Run Record: Exam/Observation	<b>P:</b> No way to change the image (gender of the patient) from this page, the user must return to the page containing demographic data. <b>S:</b> Set up two radio buttons above the image to allow the paramedic to change the gender.	Control Flexibility	2
Run Record: Patient TX	<b>P:</b> "Responses to TX" is separate from the medication (listed above.) There could be a number of medications but there is only one response slot (Note this may not be a problem at all.) <b>S:</b> ?	Match	2
Report	<b>P:</b> Once you click on "report", the last section in the previous "report" session is the default. There is no absolute default page (even across patients.) <b>S:</b> Set a default section.		2
Comms	<b>P:</b> Bandwidth is displayed in numbers. It could be a bit too complicated for paramedics. <b>S:</b> Could be better implemented as graphs.	Consistency Match	1.67
Report: Release:	<b>P:</b> No way to input signature. <b>S:</b> Should this page be printed out and have patients sign on paper?	Match	1.67
Run Record: Exam/Observation	You can have only one number on the body image, but it allows you to add more symptom items (Note: this may not be a usability problem at all if it is ok for the paramedic to enter symptoms here without specifying where they are on the body image.) No connections between the numbers and the GUI widgets.	Match	1.33

**Table 2.2. Heuristics Violations: Sorted by Severity Ratings**

– Physician's Station

Function: Section	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
Overall	<b>P:</b> No indication as to which EMS (of multiple ones) the current record is from. <b>S:</b> Display the AmbID/patient's name on EACH function/section page, and at a prominent location.	Memory Visibility Error	4
Videos	<b>P:</b> Preset cam #1 does not work, 2 and 3 are working <b>S:</b> fix the bug	bug	4
Overall	<b>P:</b> How does the physician know how to divide his or her time among different ambulances/patients? The patient list does not provide information for the physician to determine priority. <b>S:</b> more information should be provided such that the ER physicians can make informed decisions.	Memory	3.33
Videos	<b>P:</b> The zoom controls do not provide sufficient feedback. For example, when the physician clicks a zoom button, the system gives no indication about the zoom level. Even when the camera is already zoomed in or out, the buttons are still clickable. Also, The meaning of “-” and “+” signs appear to be arbitrary. <b>S:</b> Display several zoom levels on a zoom bar and allow the physician to randomly pick one at any time. Make this control similar to the one used on the drivers map.	Visibility Feedback Error	3.33
Videos	<b>P:</b> Once an area of interest is selected, if the physician left clicks the mouse, the red boundary disappears (but the area is still there.) To take away the area, one has to right click the mouse. <b>S:</b> Action should be done by left-click. Right click is for selection	Consistency	3.33
Run Record: On-Scene	<b>P:</b> The “Refresh Records” button (a function button) is embedded in the patient's data and hard to see. Also clicking this button gives no feedback. <b>S:</b> Move this button to a more prominent location (at the top, near the section tabs.) Provide visual feedback (change the cursor or display a message) when the physician clicks this button. Or integrate it into a top menu bar with other major functions such as “save”.	Visibility Feedback	3
Videos	<b>P:</b> AmbID is a pull-down menu but is hard to see because of low contrast; the patient's name is not shown here. <b>S:</b> Change the background of the pull-down menu to	Consistency visibility	3

	increase visibility; Move this pull-down to a more prominent location (top left corner;) Display patient's name along with AmbID.		
Videos	<b>P:</b> The small and big video windows are out of sync. Changes do not happen at the same time. The big video window changes first. <b>S:</b> fix the bug	Bug?	3
Vitals	<b>P:</b> On the middle panel, the "X" button's function is hard to determine. <b>S:</b> Label this button in text.	Visibility	3
Vitals	<b>P:</b> Will "Update BP Now" overwrite the automatic BP setting? How does it proceed (does the paramedic need to get the BP or does it get from the paramedic's data automatically?) <b>S:</b> the buttons should be redesigned to avoid the ambiguity.	Visibility Match Memory	3
Overall	<b>P:</b> All sections within "Run Record" are much the same as on the paramedic's station. However, the normal text fields and pull-down menus (though deactivated) give rise to the false impression that the physician can change the data. There is no indication that they will never be active. <b>S:</b> If the data are never editable, display them in pure text instead of in text box fields. If the controls/buttons can never be used, remove them from the screen.. If the controls may sometimes be used, find a way to make these items look inactive and make sure the users know how to activate them.	Match Consistency Visibility	2.67
Videos	<b>P:</b> Numbers for the preset are clickable but look like text, not clickable buttons. Once clicked, the feedback (the number becomes red) is too small. <b>S:</b> The two should be combined into one clickable icon.	Visibility	2.67
Videos	<b>P:</b> If cam1 is on, the physician should have no control but the controls are still activated and clickable. <b>S:</b> De-activate camera controls and make sure they are visually deactivated.	Visibility Match	2.67
Vitals	<b>P:</b> On "Auto BP control" panel, one needs to go through two steps to set interval (first click a number and then click "set interval"), and once the interval is set, there is no visual feedback as to which one is now in effect. <b>S:</b> Merge the two steps into one (clicking a number sets the interval.) The number remains depressed to indicate the current BP interval.	Minimalist Feedback	2.67
Map	<b>P:</b> Drop-down menus for Range and Ambulance	Visibility	2.67

	appear to be text fields <b>S:</b> Change background of the pull-down menus; make the down arrow visible.	Consistency	
Run Record: On-Scene	<b>P:</b> Message displayed beside the vehicle is inconsistent with the actual action allowed (the physician should not set anything for the vehicle involved.) <b>S:</b> Take away the message and the arrow button to the right of the vehicle image.	Message Consistency Visibility	2.33
Videos	<b>P:</b> Both of the upper two other cameras are actually menus but look just like text fields. <b>S:</b> Change the background of the pull-down menus to increase visibility.	Consistency Visibility	2.33
Videos	<b>P:</b> Orientation of the human figure is incongruent with the spatial orientation of the video image. <b>S:</b> Align the human figure with video image.	Match	2.33
Videos	<b>P:</b> The two other cameras do not have thumbnail images as the other three. <b>S:</b> Provide consistent thumbnails for all cams	Consistency	2.33
Map	<b>P:</b> The middle button on the map control panel (among the navigation arrow buttons) has two modes "Center" and "scroll," but they are not readily visible. <b>S:</b> The middle button should not be used as a mode button. Same as on the paramedic's workstation.	Visibility	2.33
Videos	<b>P:</b> The preset is patient-centered while the zoom control is physician-centered. <b>S:</b> Pick either one but not both	Match	2
Vitals	Did not find "pause" "unpause" buttons.		

**Table 2.3. Heuristics Violations: Sorted by Severity Ratings**

**– Driver’s Station**

<b>Function: Section</b>	<b>Problem Description (P) Recommended Solution (S)</b>	<b>Heuristics Violated</b>	<b>Severity Rating</b>
On the map	System response is too slow.		4
On the map	<b>P:</b> The system crashed when the address did not match the zip code. <b>S:</b> fix the bug	Bug	4
Track Ambulance	<b>P:</b> Once a user initiates “calculating route”, there is no way to cancel it, though the button is there. Calculating route can take a long time (more than a minute), giving users an impression that the process might be dead. <b>S:</b> Provide a way to cancel this process and show its progress	Control Feedback	3.67
On the map	<b>P:</b> When putting in destination, “street destination” is highlighted. Click again, the system removes the route and leaves the fields empty. <b>S:</b> fix the bug	Bug?	3.5
Select Feature	<b>P:</b> Icons are hard to recognize because of low contrast. <b>S:</b> Increase contrast.	Visibility	3
Edit street map	<b>P:</b> Radio buttons are used as action buttons. <b>S:</b> Use buttons instead of radio buttons.	Consistency	3
Reference	<b>P:</b> Reference points are labeled as No.1, No.2, etc. There is no indication as to what a reference point represents. Once No. 1 is removed, the original No. 2 becomes No. 1. <b>S:</b> Allow a user to label reference points. Don’t change the numbers when a point is deleted.	Memory Consistency	3
Track Ambulance	<b>P:</b> Once a user initiates “Track Ambulance”, the system provides no indication about the current mode. <b>S:</b> Keep the “Track Ambulance” button depressed, or display a text message on the map. Consider a checkbox next to track ambulance: if checked the ambulance is being tracked, otherwise it is not.	Feedback Memory Visibility	3
On the map	<b>P:</b> To mark the destination, one has to click just on the line for a road. The system doesn’t accept a slightly off-line click. <b>S:</b> Make it more flexible while accepting a mouse click as the input.	Flexibility	3

On the map	<p><b>P:</b> Once calculating a route, the user can't do anything before clicking "clear route".</p> <p><b>S:</b> Add a "cancel" button</p>	Control Visibility	3
Select Feature	<p><b>P:</b> Most icons do not appear to correspond to standard symbology and may therefore be difficult to understand.</p> <p><b>S:</b> Improve icon design by using standard icons or designing more intuitive icons.</p>	Consistency	2.67
Street Address:	<p><b>P:</b> No default value for town/city.</p> <p><b>S:</b> Should default to the town/city in which the EMS is located.</p>	Flexibility Memory	2.67
Track Ambulance	<p><b>P:</b> Once a user selects "mark destination", there is no feedback on the map.</p> <p><b>S:</b> Mousepointer should change to indicate the mode.</p>	Visibility Feedback	2.67
Hide route:	<p><b>P:</b> There is no feedback to show that the route is there but hidden.</p> <p><b>S:</b> Design a complimentary "Show Route" button which is only active when a route is available, but has been hidden.</p>	Feedback Visibility	2.67
On the map	<p><b>P:</b> The map is not directly manipulable. No way to directly click on the map to give the address input.</p> <p><b>S:</b> make the objects on the map manipulable.</p>	Control	2.67
On the map	<p><b>P:</b> When removing a landmark, the button says "set"</p> <p><b>S:</b> Label the button "Remove".</p>	Consistency language	2.67
On the map	<p><b>P:</b> Once a mode is selected, the mouse pointer doesn't change to indicate the mode one is in.</p> <p><b>S:</b> Provide feedback by changing the mouse pointer. Without a mouse pointer (such as with the touch screen), provide an onscreen visual indication of the mode the system is in.</p>	Feedback Visibility	2.67
On the map	<p><b>P:</b> How does one go back to no-route (to remove the route) other than initiate "new route"?</p> <p><b>S:</b> provide such an option</p>	Control	2.5
Overall	<p><b>P:</b> Top address fields look like they are editable but they are actually not.</p> <p><b>S:</b> Display the information in text instead of as text fields.</p>	Visibility Consistency	2.33
Select Feature	<p><b>P:</b> "Exit" is ambiguous since it is also commonly used in computer dialogue, meaning to close the current window or application.</p> <p><b>S:</b> Change to "Road Exit".</p>	Message	2.33
On the map	<p><b>P:</b> There is no way to find out what an icon means.</p>	Memory	2.33

	<b>S:</b> Once the mouse is pointed to an icon, display a tooltip to tell what it represents.		
On the map	<b>P:</b> No heads-up orientation of the map. <b>S:</b> Consider providing such a function as this may be the most useful display for the driver	Match	2.33
Reference	<b>P:</b> Zoom control is far away from Map Display control panel. <b>S:</b> Put the two next to each other.	Visibility	2
Track Ambulance	<b>P:</b> On the Map Display control panel, N, S, W, E are also clickable but they do not look like they are. <b>S:</b> Add arrows on these buttons and put N, S, W, E outside the buttons.	Visibility	2
On the map	<b>P:</b> Can't re-open a street or remove a landmark directly on the map. <b>S:</b> Allow these operations directly on the map.	Control	2

## **APPENDIX 2**

### **Usability Engineering of Digital EMS**

#### **-- Heuristic Evaluation of Version 2 Mockup**

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## **1. EXECUTIVE SUMMARY**

The following report gives the results of the heuristic evaluation of the mockup of DEMS version 2 created for Liberty County Paramedics.

As guided by the design team, we only focused on the higher level usability issues, not the detailed GUI designs.

It is important to realize that heuristic evaluations do not reveal major missing functionality, the compatibilities between system functions and user tasks, and the workflow of the tasks. Other usability engineering techniques, such as functional, user, and task analyses can indicate what is right with the system and identify the most appropriate functionality. We are in an early of conducting a task analysis for DEMS.

We found 47 violations of the 14 usability heuristics for higher level usability design in the mockup. Visibility and Match are the two heuristics with most violations (13 and 9, respectively). The next two categories are Consistency and Language, each with 7 violations.

There are 2 catastrophic violations that received severity ratings over 3.50. It is imperative to fix them. 15 violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. 9 violations are minor violations (between 1.50 and 2.50) that have low priority in fixing

For every heuristic violation, we recommended a potential solution. Tables 1 and show the details of the violations and recommended solutions.

Please note again that we need to use other techniques to cover other higher-level usability issues.

## **2. METHODOLOGY**

The heuristics evaluation methodology adopted here is a discount usability technique that is used to identify the major usability problems of a product in a timely manner with reasonable cost. This technique requires three or more usability experts to independently apply a set of usability heuristics to a product, identify violations of the heuristics, and assess the severity of each violation.

The three usability experts (evaluators) for the evaluation of Digital EMS Version 2 Mockup are Dr. Jiajie Zhang, Dr. Todd R. Johnson, and Ms. Zhihua Tang. They evaluated the user interface and generated a list of heuristics violations according to the fourteen heuristics described below. This list was given to the three evaluators who then independently accessed the severity of each violation. The ratings from the three evaluators were averaged. The averaged ratings are reported. The next two sections describe the usability heuristics used for Digital EMS and the scale of the severity rating.

## 2.1 Usability Heuristics

The following fourteen heuristics were developed by Jiajie Zhang and Todd R. Johnson. The words in the brackets are the semantic tags for the heuristics.

1. **[Consistency] Consistency and Standards.** Users should not have to wonder whether different words, situations, or actions mean the same thing. Standards and conventions in web design should be followed.
  - a. Sequences of actions (skill acquisition)
  - b. Color (categorization)
  - c. Layout and position (spatial consistency)
  - d. Font, capitalization (levels of organization)
  - e. Terminology (delete, del, remove, rm) and language (words, phrases)
  - f. Standards (e.g., blue underlined text for unvisited hyperlinks)
2. **[Visibility] Visibility of System State.** Users should be always informed what is going on with the system through appropriate feedback and display of information.
  - a. What is the current state of the system?
  - b. What can be done at current state?
  - c. Where can users do?
  - d. What change is made after an action?
3. **[Match] Match between System and World.** The image of the system perceived by users should match the model the users have about the system.
  - a. User model matches system image
  - b. Actions provided by the system should match actions performed by users
  - c. Objects on the system should match objects of the task
4. **[Minimalist] Minimalist.** Any extraneous information is a distraction and a slow-down.
  - a. Less is more
  - b. Simple is not equivalent to abstract and general
  - c. Simple is efficientProgressive levels of detail
5. **[Memory] Minimize Memory Load.** Users should not be required to memorize a lot of information to carry out tasks. Memory load reduces users' capacity to carry out the main tasks.
  - a. Recognition vs. recall (e.g., menu vs. commands)
  - b. Externalize information through visualization
  - c. Perceptual procedures
  - d. Hierarchical structure
  - e. Default values
  - f. Concrete examples (DD/MM/YY, e.g., 10/20/99)
  - g. Generic rules and actions (e.g., drag objects)
6. **[Feedback] Informative Feedback.** Users should be given prompt and informative feedback about their actions.
  - a. Direct perception (7 stage model)

- b. Information that can be directly perceived and interpreted.
- c. Levels of feedback (novice and expert)
- d. Concrete and specific, not abstract and general.
- e. Response time
  - 0.1 second for instantaneously reacting
  - 1.0 second for uninterrupted flow of thought
  - 10 seconds for the limit of attention

7. **[Flexibility] Flexibility and efficiency.** Users always learn and users are always different. Give users the flexibility of creating customization and shortcuts to accelerate their performance.

- a. Shortcuts for experienced users
- b. Shortcuts or macros for frequently used operations
- c. Skill acquisition through chunking
- d. Examples:
  - Abbreviations, function keys, hot keys, command keys, macros, aliases, templates, type-ahead, bookmarks, hot links, history, default values, etc.

8. **[Message] Good Error Messages.** The messages should be informative enough such that users can understand the nature of errors, learn from errors, and recover from errors.

- a. Phrased in clear language, avoid obscure codes
  - e.g., “system crashed, error code 147”
- b. Precise, not vague or general.
  - e.g., “Cannot open document”
- c. Constructive
- d. Polite
  - e.g., “illegal user action”, “job aborted”, “system was crashed”, “fatal error”, etc.

9. **[Error] Prevent Errors.** It is always better to design interfaces that prevent errors from happening in the first place.

- a. Interfaces that make errors impossible.
- b. Avoid modes (e.g., vi, text wrap.). Or use informative feedback, e.g., different sounds.
- c. Execution error vs. evaluation error
- d. Various types of slips.

10. **[Closure] Clear Closure.** Every task has a beginning and an end. Users should be clearly notified about the completion of a task.

- a. Clear beginning, middle, and end.
- b. Complete 7-stages of actions.
- c. Clear feedback to indicate goals are achieved and current stacks of goals can be released.
  - e.g., dialogues.

11. **[Undo] Reversible Actions.** Users should be allowed to recover from errors. Reversible actions also encourage exploratory learning.
  - a. At different levels: a single action, a subtask, or a complete task
  - b. Multiple steps
  - c. Encourage exploratory learning
  - d. Prevent serious errors
12. **[Language] Use Users' Language.** The language should be always presented in a form understandable by the intended users.
  - a. Use standard meanings of words
  - b. Specialized language for specialized group
  - c. User defined aliases
  - d. Users' perspective
    - e.g., "we have bought four tickets for you" vs. "you bought four tickets"
13. **[Control] Users in Control.** Don't give users that impression that they are controlled by the systems.
  - a. Users are initiators of actors, not responders to actions.
  - b. Avoid surprising actions, unexpected outcomes, tedious sequences of actions, etc.
14. **[Document] Help and Documentation.** Always provide help when needed.
  - a. Context-sensitive help
  - b. Four types of help
    - task-oriented
    - alphabetically ordered
    - semantically organized
    - search
  - c. Help embedded in contents

## 2.2 Severity Rating Scale

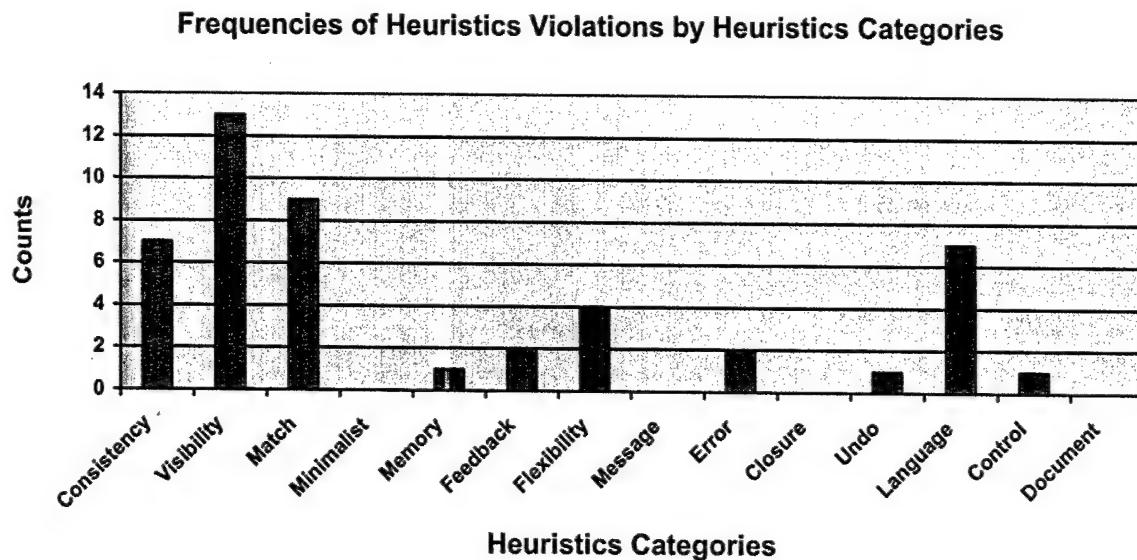
The following scale is used for the assessment of the severity of each heuristic violation.

- 0 = I don't agree that this is a usability problem at all
- 1 = Cosmetic problem only: need not be fixed unless extra time is available on project
- 2 = Minor usability problem: fixing this should be given low priority
- 3 = Major usability problem: important to fix, so should be given high priority
- 4 = Usability catastrophe: imperative to fix this before product can be released

As a guideline for rating the problems, we consider the proportion of users who will experience it, the impact it will have on their experience with the product, and whether the usability problem will be a problem only the first time they encounter it, or whether it will persistently bother them. A persistent problem with a major impact that most users will encounter will get the highest severity rating.

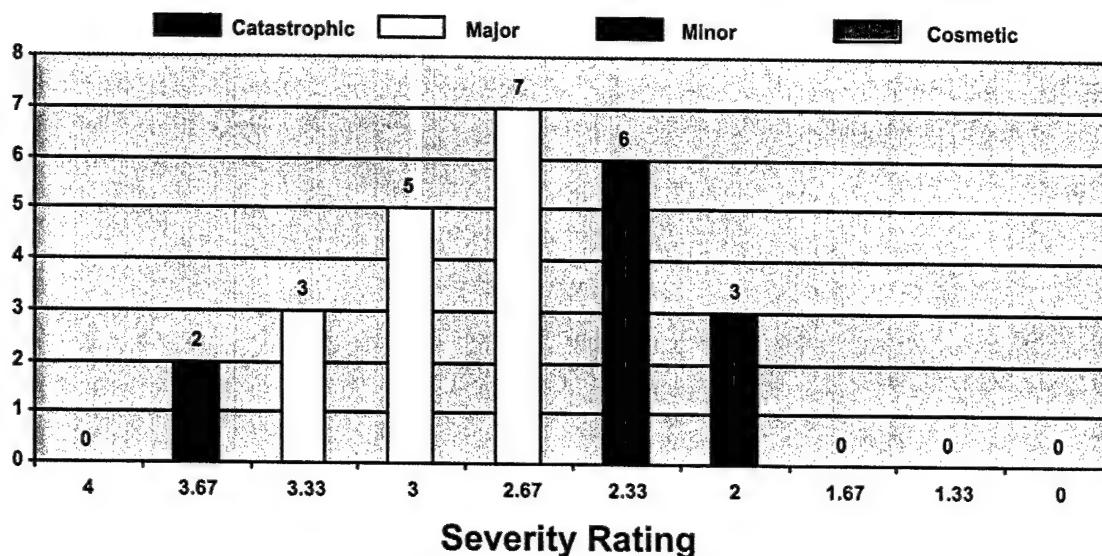
### 3. RESULTS

Figures 1, 2, and 3 show the heuristics violations in Digital EMR Version 2 Mockup along different dimensions. See the figure captions for explanations. Table shows details of the violations ordered by places of occurrences, and Table 2 shows them sorted by severity ratings. Potential solutions were recommended for all the violations in the tables.



**Figure 1.** The 14 usability heuristics used for evaluations were violated 47 times. Visibility and Match are the two heuristics with most violations (13 and 9, respectively). The next two categories are Consistency and Language, each with 7 violations.

### Frequencies of Heuristics Violations by Severity



**Figure 2.** There are 2 catastrophic violations that received severity ratings over 3.50. It is imperative to fix them. 15 violations are major violations (severity ratings between 2.50 and 3.50) that are important to fix and should be given high priority. 9 violations are minor violations (between 1.50 and 2.50) that have low priority in fixing.

**Table 1. Heuristics Violations: by Places of Occurrences**

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
Overall	“Shut Down” button appears as a sub-menu item (located on the right side) on many slides. For the purpose of enabling instant system shut down, it is better to keep it at a fixed location at the bottom of the screen, where the top-level menu items are displayed.	Consistency Visibility Flexibility Error	3.33
	P: The two levels of navigation bars are not visually distinct and their hierarchical structure is not visually perceivable. S: The two levels of navigation bars should be made visually distinct, and their relation should be made clear.	Visibility	3.50
#1, Login	P: The system could be shut down by clicking the “Shut Down” button unintentionally. S: Once the button “Shut Down” is clicked, the system should provide a message for user’s confirmation.	Undo Error	3.67
#2, System/ System Menu	P: The meanings of “systems” and “system menu” are not clear. S: Labeled the two in a different way (e.g., “System Menu” may be labeled “Overview”).	Match Language	2.50
	P: The patient name list contains three variables. It could be hard to immediately recognize a patient’s name from the list. S: The name list should be organized to fit the task (the most important information should be displayed first). Also, should there be a default patient? It would be good if the three variables of the patient can be sorted.	Visibility Flexibility Control	2.33
#3, Medic Sign In/Out	P: Medic’s name is displayed in three fields that are visually separated. S: Display a medic’s name in one field.	Visibility	2.0
	P: The process to sign in/out is not based on the object-action paradigm (i.e., select a person and perform an action.) S: Add two more buttons, “Sign In” and “Change Skill”, on the display, to go along with “Sign Out”. When “Sign In” is clicked, popup window appears for login. When “change skill” is clicked, only the skill set is displayed. When “sign out” is clicked, only password is prompted.	Consistency Match Visibility	3.33

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
	<p><b>P:</b> The Sign-In pop-up window has a button “Change Skill”. When a medic newly signs in, what needs to be done is to set, rather than to change, skill level.</p> <p><b>S:</b> This might be better implemented as a pull-down menu labeled as “Set Skill”. See the previous discussion.</p>	Match Flexibility	2.67
#4, Manage Run Records	<p><b>P:</b> The word “load” is used to label column or buttons. This word pertains more to the software than to the medic’s task, and so may not be easily understood.</p> <p><b>S:</b> Use the word “activate” instead of “load” for labels (e.g., “Activated?”, “Activate Record” and “Deactivate Record”).</p>	Language Match	2.67
	<p><b>P:</b> The functions of the buttons “Audit &amp; Close” and “Transmit &amp; Purge” are not quite clear.</p> <p><b>S:</b> If the two functions on one single button are always bundled together, it is better to re-label these two buttons and make sure that the labels are easy to understand.</p>	Language	2.0
#5, Active Run Records/ Personal Info/Med HX	<p><b>P:</b> Medication has three relevant fields “Medication”, “Route” and “Dosage”. The two buttons below, “Add” and “Delete”, are separated; giving the false impression that each applies to different field. The two buttons under fields “Allergies” and “Symptoms” have the same problems.</p> <p><b>S:</b> Put the respective “Add” and “Delete” buttons close to each other.</p>	Visibility	2.33
	<p><b>P:</b> When a patient’s driver’s license is scanned in, the pop-up window for confirmation does not provide any information that has just been scanned in. The user may not know whether the data being display is the data for the patient whose card is just scanned.</p> <p><b>S:</b> The pop-up window should display the information just scanned in.</p>	Feedback Visibility Memory	3.0
#6, Run Record Information	<p><b>General consideration:</b> How does the system deal with multiple patients? The answer to this question will determine how to make the design match the workflow.</p>	Needs task analysis	

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
#7, On-Scene	<p><b>P:</b> “Auto Insurance” and “Police Crash Report” do not look like they are clickable and editable.</p> <p><b>S:</b> Provide visual cue to indicate that these two are clickable. Or consider change it to another format.</p>	Visibility Match	2.67
#8, Vital Signs	<p><b>P:</b> “Propaq on this Patient” is implemented as a button but actually it indicates a state (whether Propaq is connected to the patient). This is called “object-symbol”—states and actions are implemented on the same object. This is good for many device designs. However, it is rarely used in computer-based GUI.</p> <p><b>S:</b> It is better to use checkbox (Is Propaq on this patient? Yes No) instead of button.</p>	Consistency Visibility	3.0
	<p><b>P:</b> The label of the button “Propaq Capture” is not task oriented.</p> <p><b>S:</b> Label the button “Capture Vital Signs”.</p>	Language Match	2.67
	<p><b>P:</b> The waveform section does not have any title that provides more information about this section, as the remaining parts on the display do.</p> <p><b>S:</b> Provide caption for this section</p>	Visibility Consistency	2.33
	<p><b>General consideration:</b></p> <ol style="list-style-type: none"> <li>1. Captured waveforms should be time-stamped;</li> <li>2. Need to consider the display order of captured waveforms;</li> <li>3. Consider the timing of taking vital signs. This will determine where to put the menu item on the screen.</li> </ol>	Needs task analysis	3.0
#9, Observations	<p><b>P:</b> The “Skin” box does not look like it is clickable.</p> <p><b>S:</b> Provide visual cues to make it function known. See the comments for #8, Vital Signs.</p>	Consistency Visibility	2.67
	<p><b>P:</b> The list of Illness/Symptoms (in the pop-up window once the “Add” button is clicked) is not organized. It is also hard to read (search) through the list because of the centering of the text.</p> <p><b>S:</b> Organize the list in a meaningful way (e.g., functionally or spatially). Make the text left-adjusted. This requires user and task analyses</p>	Match Visibility	3.0

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
	<p><b>P:</b> The sequence to indicate the illness on the body is not clear. Once the button “Add” is clicked, the system waits for the user to indicate the location on the body but gives no indication.</p> <p><b>S:</b> Provide a message when the “Add” button is clicked. Or reverse the sequence so that the user first clicks on the body and then click “Add”. Or clicking a body part brings the pop-up box directly.</p>	Visibility Flexibility Feedback	3.33
#10, Treatment/ Techniques	<p><b>Considerations:</b></p> <ol style="list-style-type: none"> <li>1. The meanings of buttons “Stop Med” and “Stop” are not clear to us.</li> <li>2. What is the purpose of ECG here and how does it relate to “Vital Signs”.</li> </ol>	Need user and task analysis	3.0
#11-13, Forms	<p><b>P:</b> The labeling of the signature fields is not complete.</p> <p><b>S:</b> Label as “Patient’s signature”, “Paramedic/EMT signature”, etc., wherever is appropriate.</p>	Consistency Match	2.33
#14, Sign and Close Run Records	<p><b>P:</b> The title on the top of the slide does not match that on the menu.</p> <p><b>S:</b> Make the two the same.</p>	Consistency	2.33
#15, Comms	<p><b>P:</b> The labeling of the menu item “Comms” is not clear.</p> <p><b>S:</b> Label it more explicitly.</p>	Language	2.0
	<p><b>P:</b> The top right section is titled “Physician View”. This labeling is incongruent with the current task.</p> <p><b>S:</b> Label this section from the medic’s point of view (e.g., “Data Sent”).</p>	Match Language	2.67
	<p><b>General consideration:</b> Redefine the purpose of this page and the function of each button.</p>	Needs task analysis	
#16, Navigation	<p><b>P:</b> The word “Navigation” may cause ambiguity since it could also mean navigation through the system.</p> <p><b>S:</b> Label the slide and the menu item “Map” instead.</p>	Language	2.33
	<p><b>General consideration:</b> Refer to the comments for the previous version.</p>		
#19, Admin/ Network Status	<p><b>General consideration:</b> Refer to the comments for the previous version</p>		

**Table 2. Heuristics Violations: Sorted by Severity Ratings**

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
#1, Login	<b>P:</b> The system could be shut down by clicking the “Shut Down” button unintentionally. <b>S:</b> Once the button “Shut Down” is clicked, the system should provide a message for user’s confirmation.	Undo Error	3.67
Overall	<b>P:</b> The two levels of navigation bars are not visually distinct and their hierarchical structure is not visually perceivable. <b>S:</b> The two levels of navigation bars should be made visually distinct, and their relation should be made clear.	Visibility	3.50
#3, Medic Sign In/Out	<b>P:</b> The process to sign in/out is not based on the object-action paradigm (i.e., select a person and perform an action.) <b>S:</b> Add two more buttons, “Sign In” and “Change Skill”, on the display, to go along with “Sign Out”. When “Sign In” is clicked, popup window appears for login. When “change skill” is clicked, only the skill set is displayed. When “sign out” is clicked, only password is prompted.	Consistency Match Visibility	3.33
#9, Observations	<b>P:</b> The sequence to indicate the illness on the body is not clear. Once the button “Add” is clicked, the system waits for the user to indicate the location on the body but gives no indication. <b>S:</b> Provide a message when the “Add” button is clicked. Or reverse the sequence so that the user first clicks on the body and then click “Add”. Or clicking a body part brings the pop-up box directly.	Visibility Flexibility Feedback	3.33
Overall	“Shut Down” button appears as a sub-menu item (located on the right side) on many slides. For the purpose of enabling instant system shut down, it is better to keep it at a fixed location at the bottom of the screen, where the top-level menu items are displayed.	Consistency Visibility Flexibility Error	3.33
#10, Treatment/ Techniques	<b>Considerations:</b> 3. The meanings of buttons “Stop Med” and “Stop” are not clear to us. 4. What is the purpose of ECG here and how does it relate to “Vital Signs”.	Need user and task analysis	3.0

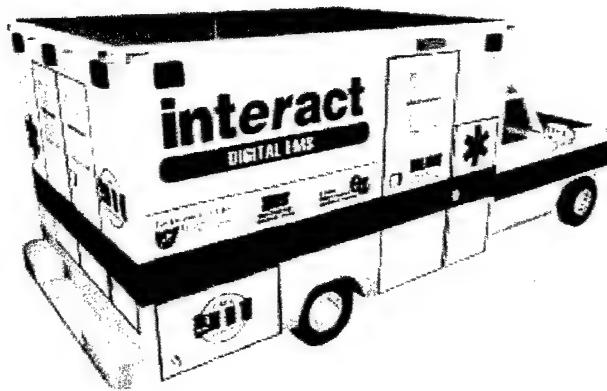
Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
#5, Active Run Records/ Personal Info/Med HX	<p><b>P:</b> When a patient's driver's license is scanned in, the pop-up window for confirmation does not provide any information that has just been scanned in. The user may not know whether the data being display is the data for the patient whose card is just scanned.</p> <p><b>S:</b> The pop-up window should display the information just scanned in.</p>	Feedback Visibility Memory	3.0
#8, Vital Signs	<p><b>P:</b> "Propaq on this Patient" is implemented as a button but actually it indicates a state (whether Propaq is connected to the patient). This is called "object-symbol"—states and actions are implemented on the same object. This is good for many device designs. However, it is rarely used in computer-based GUI.</p> <p><b>S:</b> It is better to use checkbox (Is Propaq on this patient? Yes No) instead of button.</p>	Consistency Visibility	3.0
#8, Vital Signs	<p><b>General consideration:</b></p> <ol style="list-style-type: none"> <li>4. Captured waveforms should be time-stamped;</li> <li>5. Need to consider the display order of captured waveforms;</li> <li>6. Consider the timing of taking vital signs. This will determine where to put the menu item on the screen.</li> </ol>	Needs task analysis	3.0
#9, Observations	<p><b>P:</b> The list of Illness/Symptoms (in the pop-up window once the "Add" button is clicked) is not organized. It is also hard to read (search) through the list because of the centering of the text.</p> <p><b>S:</b> Organize the list in a meaningful way (e.g., functionally or spatially). Make the text left-adjusted. This requires user and task analyses</p>	Match Visibility	3.0
	<p><b>P:</b> The top right section is titled "Physician View". This labeling is incongruent with the current task.</p> <p><b>S:</b> Label this section from the medic's point of view (e.g., "Data Sent").</p>	Match Language	2.67
#3, Medic Sign In/Out	<p><b>P:</b> The Sign-In pop-up window has a button "Change Skill". When a medic newly signs in, what needs to be done is to set, rather than to change, skill level.</p> <p><b>S:</b> This might be better implemented as a pull-down menu labeled as "Set Skill". See the previous discussion.</p>	Match Flexibility	2.67

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
#4, Manage Run Records	<p><b>P:</b> The word “load” is used to label column or buttons. This word pertains more to the software than to the medic’s task, and so may not be easily understood.</p> <p><b>S:</b> Use the word “activate” instead of “load” for labels (e.g., “Activated?”, “Activate Record” and “Deactivate Record”).</p>	Language Match	2.67
#7, On-Scene	<p><b>P:</b> “Auto Insurance” and “Police Crash Report” do not look like they are clickable and editable.</p> <p><b>S:</b> Provide visual cue to indicate that these two are clickable. Or consider change it to another format.</p>	Visibility Match	2.67
#8, Vital Signs	<p><b>P:</b> The label of the button “Propaq Capture” is not task oriented.</p> <p><b>S:</b> Label the button “Capture Vital Signs”.</p>	Language Match	2.67
#9, Observations	<p><b>P:</b> The “Skin” box does not look like it is clickable.</p> <p><b>S:</b> Provide visual cues to make it function known. See the comments for #8, Vital Signs.</p>	Consistency Visibility	2.67
#2, System/ System Menu	<p><b>P:</b> The meanings of “systems” and “system menu” are not clear.</p> <p><b>S:</b> Labeled the two in a different way (e.g., “System Menu” may be labeled “Overview”).</p>	Match Language	2.50
#11-13, Forms	<p><b>P:</b> The labeling of the signature fields is not complete.</p> <p><b>S:</b> Label as “Patient’s signature”, “Paramedic/EMT signature”, etc., wherever is appropriate.</p>	Consistency Match	2.33
#14, Sign and Close Run Records	<p><b>P:</b> The title on the top of the slide does not match that on the menu.</p> <p><b>S:</b> Make the two the same.</p>	Consistency	2.33
#16, Navigation	<p><b>P:</b> The word “Navigation” may cause ambiguity since it could also mean navigation through the system.</p> <p><b>S:</b> Label the slide and the menu item “Map” instead.</p>	Language	2.33
#2, System/ System Menu	<p><b>P:</b> The patient name list contains three variables. It could be hard to immediately recognize a patient’s name from the list.</p> <p><b>S:</b> The name list should be organized to fit the task (the most important information should be displayed first). Also, should there be a default patient? It would be good if the three variables of the patient can be sorted.</p>	Visibility Flexibility Control	2.33

Slide #	Problem Description (P) Recommended Solution (S)	Heuristics Violated	Severity Rating
#5, Active Run Records/ Personal Info/Med HX	<p><b>P:</b> Medication has three relevant fields “Medication”, “Route” and “Dosage”. The two buttons below, “Add” and “Delete”, are separated; giving the false impression that each applies to different field. The two buttons under fields “Allergies” and “Symptoms” have the same problems.</p> <p><b>S:</b> Put the respective “Add” and “Delete” buttons close to each other.</p>	Visibility	2.33
#8, Vital Signs	<p><b>P:</b> The waveform section does not have any title that provides more information about this section, as the remaining parts on the display do.</p> <p><b>S:</b> Provide caption for this section</p>	Visibility Consistency	2.33
#15, Comms	<p><b>P:</b> The labeling of the menu item “Comms” is not clear.</p> <p><b>S:</b> Label it more explicitly.</p>	Language	2.0
#3, Medic Sign In/Out	<p><b>P:</b> Medic’s name is displayed in three fields that are visually separated.</p> <p><b>S:</b> Display a medic’s name in one field.</p>	Visibility	2.0
#4, Manage Run Records	<p><b>P:</b> The functions of the buttons “Audit &amp; Close” and “Transmit &amp; Purge” are not quite clear.</p> <p><b>S:</b> If the two functions on one single button are always bundled together, it is better to re-label these two buttons and make sure that the labels are easy to understand.</p>	Language	2.0
#6, Run Record Information	<p><b>General consideration:</b> How does the system deal with multiple patients? The answer to this question will determine how to make the design match the workflow.</p>	Needs task analysis	
#15, Comms	<p><b>General consideration:</b> Redefine the purpose of this page and the function of each button.</p>	Needs task analysis	
#16, Navigation	<p><b>General consideration:</b> Refer to the comments for the previous version.</p>		
#19, Admin/ Network Status	<p><b>General consideration:</b> Refer to the comments for the previous version</p>		

## APPENDIX3

### DIGITAL EMS (DEMS) SOFTWARE DEVELOPMENT



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## **Abstract**

The Digital EMS (DEMS) software development plan calls for several key elements to ensure a quality product with which the customer will be satisfied. These areas are as follows: customer requirements definition, functional requirements definition, testing plan (includes independent verification and validation in a dedicated testing environment), and emergency scenario based testing scripts. Together, these elements will provide a foundation to test the Digital EMS software. This document will focus on the documenting of DEMS software development including the interagency interactions (policy & procedure) specifications and diagrams (*DEMS software development Task 1*).

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## 1. Background

The Digital EMS is a conventional ambulance that has been augmented with the latest technology to provide a means of communication between the paramedics and the hospital physicians. The aim of this project is to extend the expertise of the physicians to a remote location. With enhanced communications, which entails real time video, audio, and data streams inter-networked between the hospital and ambulance, physicians will be able to advise the paramedics on procedures and methods that otherwise would not be possible. As a side benefit, the Digital EMS (DEMS) will provide extra functionality to the remotely located paramedics such as: real time map navigation, enroute emergency protocol documentation, online run record reporting, and online training.

Together, Digital EMS(DEMS) and Interact™ are the centerpiece of the Disaster Relief and Emergency Medical Services (DREAMS™) project. DREAMS™ is using rapidly developing computer and telecommunications technology and new research in basic and clinical science to improve trauma victims' survival, especially in remote areas and battlefields beyond the physical reach of specialists in well-equipped trauma centers.

Testing of the concept and technology behind Digital EMS has been underway in suburban Houston since 1995. The project's efforts are focusing on using the Digital EMS digital communications technology to bring life-saving care for trauma victims to rural areas of the country and other places beyond the reach of conventional emergency rooms. Planners expect the high-capacity digital communications system eventually will be used to upgrade trauma care at small rural hospitals and be installed in trauma helicopters. It will be used to treat trauma casualties anywhere conventional advanced emergency medical treatment is unavailable – in military operations, offshore drilling operations and NASA orbital missions.

Through DEMS, help arrives in real time. This speed is possible because of sophisticated digital data and image acquisition, compression, and information processing and communications management techniques engineers are now combining into a reliable, easy-to-use package.

Digital EMS combines real-time physician mentoring of emergency personnel, provide access to patients' medical records, advanced therapies and up-to-date regional ambulance and hospital availability to be sure each patient is transported to the appropriate facility in the shortest time.

## 2. Purpose

The purpose of this document is to define the software functional requirements associated with the design and development of the Digital Emergency Medical System (DEMS).

## 3. Agencies Providing DEMS Functional Requirements

The agencies that are involved in providing DEMS functional requirements are Liberty County Emergency Medical Services (LCEMS), University of Texas Health Science Center Houston(UTHSCH), Texas A&M University System (TAMUS), and Herman Hospital(H-H). Included in the notes of a technical meeting held at TEES dated 06-26-2002 an example is provided of the above listed agencies and their contribution and effect on DEMS functional requirements. An excerpt of their contribution is shown next. For more detail see "Summary of Technical Meeting Held at TEES, 2002-06-26" page 21 of this document.

UTHSCH will provide to TAMUS a data dictionary of all of the concepts contained in the LCEMS run sheets, medical protocols, and SOPs. Data dictionary will include: concept id number, concept name (short), concept name (long), concept definition, reference name, reference name source, type of value (text, integer, float, coded, etc.), normal, abnormal, critical, and absolute ranges (where appropriate), is it a repeated measure, and the units of measure to be used (where appropriate).

UTHSCH will work with TAMUS to create one or more information models to represent the clinical and non-clinical information about each patient care encounter (this includes the incident information, vehicle information, administrative information, and patient-care information). These information models will be used to instantiate a database, provide an intellectual model for use when designing and discussing patient care and clinical decision support, provide a foundation for data interchange functions.

TAMUS will instantiate the data model in a manner that meets the clinical data needs of the physicians, EMTs, and provider-extenders (e.g., medical protocols). Instantiation may be in the form of a database.

TAMUS will develop APIs to the instantiated data model to meet the medical data storage and retrieval needs. UTHSCH will provide a list of the needed functions.

## **4. DEMS Functional Requirements Definition**

This section provides a high level description of the functionality of each area of the DEMS software.

### **4.1 The Physician's Functional Requirements Definition**

The Physician's functional requirements area shall comprise a workstation environment, associated software, and telecommunications resources to allow the Physician monitoring the EMTs (EMS field team) sufficient functionality to utilize the full capacities of the DEMS environment. The Physician's workstation facility shall include a table surface, a computer workstation (of sufficient resources to facilitate the operation), video monitors, telephones, computer networking facilities, cameras, and microphones as needed.

#### **4.1.1 Run Record Display**

This functional area allows the Physician to be able to view patient run records. The run record is subdivided into five pages of forms with the first page, entitled "On-Scene," containing basic patient and incident information and a motor/vehicle survey. All run record data entered by ambulance paramedics is automatically transmitted to the hospital at specified time intervals, thus ensuring that the Physician is viewing up-to-date run record data at all times. Located in the bottom border of the "Interact™" window are a small arrow button and non-editable field identifying the patient's name. The Physician can switch between patients' forms by pressing the small arrow button, which displays a pop-up list of patients currently stored in the system. The Physician is restricted to read-only viewing of the run records, currently based on "LOCATION" (e.g. Ambulance 1, Ambulance 2, etc.) with 1 patient per LOCATION, and cannot modify any data. The Physician Workstation H-H needs to be able to handle multiple LOCATIONS with multiple patients per LOCATION. The "Exam/Observation" page of the run record contains the primary survey of the patient. The "Patient HX" page of the run record contains background history of the patient. The "Patient TX" page of the run record contains a timestamp log of all medications administered to the patient. The "Narrative" page of the run record contains free-

form text area in which the Physician can view the narrative details of the incident scene, transport, treatment and treatment response of the patient.

#### **4.1.2 Video Display and Control**

This functional area allows the Physician to be able to immediately view video of the patient as well as vitals sign patient data. Three on-board cameras have been integrated into the DEMS, enhancing communication between the ambulance and the hospital by providing the Physician on call with a virtual “window” into the ambulance. The Physician has full rotation and zoom control over the three on-board cameras.

#### **4.1.3 Sound**

This functional area will allow the Physician to be able to hear and record all sounds coming from the ambulance in real time. This is to ensure that the Physician can hear both the enroute patient and the paramedics.

#### **4.1.4 Vitals Sign Display**

The Physician will be able to see real time readout of the patient’s major vitals signs: heart rate, blood pressure, and air flow.

#### **4.1.5 Mapping Display**

This is a map that shows the location of the ambulance, its direction of travel, and its estimated arrival time.

### **4.2 The Paramedic’s Functional Requirements Definition**

The Paramedic’s functional area shall comprise a mobile workstation environment (fully contained in the ambulance), associated software, and telecommunications resources to allow the Paramedics in the EMS to sufficiently convey the situation in the DEMS environment. The ambulance shall include three cameras, microphone, speaker, two workstations, vitals sign monitor, and a means of communicating the data back to the hospital workstation.

#### **4.2.1 Automated Emergency Run Record Management**

The Paramedics shall be able to enter all of the information as described in section 4.1.1 above.

#### **4.2.2 Video Display**

This functional area allows the Paramedics to be able to immediately view video of the patient as well as vitals sign patient data. Three on-board cameras have been integrated into the DEMS, enhancing communication to the hospital by providing the Physician on call a virtual “window”

into the ambulance. The Physician has full rotation and zoom control over the three on-board cameras. The Video/Vitals screen enables the Paramedics to view, in real time, the exact camera angle, zoom, and resulting video that is being transmitted to the Physician.

#### **4.2.3 Vitals Sign Display**

A Propaq vitals signs monitor (Protocol System, Inc.) has also been integrated into DEMS, enabling real-time patient vitals sign display, capture, and transmission. This enhances the Paramedic's ability to not only review historical vitals signs data for post-incident review, but also provides timely communication of the patient's condition to the hospital Physician. This Video/Vitals screen displays both the live video transmitted to the Physician as well as the patient's vitals sign data.

#### **4.2.4 Emergency Protocols**

This functional area will provide the Paramedics with a flow-based, nominal set of agency-approved protocols which the Paramedic may access and perform without Physician approval. The Protocol pages are implemented in standard hypertext markup language (HTML) format in which underlined words contain links to other pages. This enables the Paramedics to simply press on the desired linked text to rapidly drill down to the desired medical protocol. Since this format is widely supported across software applications and the World Wide Web, additional protocols can be integrated quickly with little modification.

#### **4.2.5 Mapping and Navigation Interface**

This functional area will allow the Paramedics to be able to enter an address or GPS coordinate as a destination, and the computer will calculate and display the best (fastest) route to the destination from the current position. It also displays the current location and a map of the surrounding environment.

#### **4.2.6 Communications Display**

This functional area will allow the Paramedics to be able to view and modify parameters affecting data communication to the hospital. The Intelligent Communications Manager (ICM) will automatically determine available bandwidth and reliability of all communication mediums at all times and coordinates their usage so as to maximize successful data transmission. From this screen, the Paramedics can view maximum and actual throughput values as well as change communication parameters and enable/disable a communication medium altogether. This screen is offered merely as a troubleshooting service to the Paramedics, since communication will be optimized automatically via the ICM.

#### **4.2.7 Run Record Report**

This functional area will allow the Paramedics to be able to view and modify time-insensitive billing and insurance information. The report data is not automatically transmitted to the hospital

since it is not time-critical information. However, it is backed up on the Paramedic's system (DEMS). The Report section is subdivided into five pages of forms. The first page, entitled "Vitals Report" contains basic incident information. The bottom half of this screen is reserved for viewing historical Propaq vitals sign data which will be under development in the near future. The "Billing" page of the run record contains responsible party and insurance information for the patient. The "Release" page of the run record report contains Release of Responsibility and Acknowledgment sections. With this form the patient can acknowledge that medical care was not recommended and that he/she is denying care. The Transport/Crew page of the run record report contains patient transport method, authorizing Physician, and destination of the patient. The "Report" page of the run record report will enable the Paramedics to preview or print the entire run record or only selected portions.

#### **4.2.8 Training**

This functional area will allow the Paramedics to be able to receive computer-based training (CBT) on-board the ambulance. The online training will provide a variety of interactive medical training courses that can be integrated into the DEMS that utilize 2D and 3D illustrations, video, voice, testing and feedback to provide a professional curriculum and meet national standards of the Department of Transportation. Integrating interactive, multimedia courses enables Paramedics to analyze case studies of real emergency calls, refresh and test their knowledge of EMS protocols, or consult an on-line medical dictionary at any time the ambulance is powered up or enroute.

### **5. DEMS Functional Requirements for (Agency) Liberty County**

The software functional requirements are separated into two main categories or functional areas (Actor: Physician's workstation H-H, Actor: Paramedics). All of the software in the Digital EMS is a sub-function of one of these two functional areas.

1. DEMS Physician's workstation H-H functional area:
  - 1.1 Run Record Display
    - 1.1.1 Provide a display of the non-modifiable copy of the Emergency Run Records being produced and/or modified in the ambulance
      - 1.1.1.1 The physician shall be able to annotate the run record
    - 1.1.2 All run record data entered by ambulance paramedics is automatically transmitted to the hospital at specified time intervals
    - 1.1.3 DEMS Displays five pages of patient information:
      - 1.1.3.1 On-Scene:
        - 1.1.3.1.1 Shows patient information and information about the scene and the situation of the emergency
        - 1.1.3.1.2 The physician will be able to switch between patients' forms(pages)
        - 1.1.3.1.3 The physician will be restricted to read-only viewing of the run records
      - 1.1.3.2 Exam/Observation:
        - 1.1.3.2.1 Will contain the primary survey of the patient
        - 1.1.3.2.2 Shows what data has been entered as input on the paramedic's interface
      - 1.1.3.3 Patient HX:
        - 1.1.3.3.1 Shows the background history of the patient
        - 1.1.3.3.2 Information obtained by verbal communication with the patient and an upload of the hospitals database

- 1.1.3.4 Patient TX:
  - 1.1.3.4.1 This is a timestamp log of all medications administered to the patient
  - 1.1.3.4.2 Shows what was given, how much was given, and when it was given
- 1.1.3.5 Narrative:
  - 1.1.3.5.1 This is a free-form text area in which the physician can view the narrative details of the incident scene, transport, treatment and treatment response of the patient
- 1.2 Video Display and Control
  - 1.2.1 Provide three viewing angles/positions
    - 1.2.1.1 One camera is a Medic-Cam
    - 1.2.1.2 The other two are mounted cameras
  - 1.2.2 Provide pan, tilt, and zoom capabilities for each camera
  - 1.2.3 Provide option to increase frame rate by selecting area of screen for high resolution
  - 1.2.4 Provide video at 30 frames per second
  - 1.2.5 Provide video display at a resolution of at least 640x480
- 1.3 Sound
  - 1.3.1 Provide sound support
    - 1.3.1.1 The physician shall be able to hear the sound from the ambulance
    - 1.3.1.2 The physician shall be able to record the sound from the ambulance
    - 1.3.1.3 The physician shall be able to speak to the people in the ambulance
    - 1.3.1.4 The sound implementation shall be full duplex
- 1.4 Vitals Display
  - 1.4.1 Show Patients vital signs in real time
    - 1.4.1.1 Electrocardiogram, leads selectable by physician or paramedic
    - 1.4.1.2 Pulse oximetry waveform and digital information breathing rate
    - 1.4.1.3 Arterial blood pressure, by waveform or digital display or systolic, diastolic and mean pressures
    - 1.4.1.4 Respiratory rate (and optional waveform)
    - 1.4.1.5 Core body temperature
    - 1.4.1.6 Electronic stethoscope wave display
  - 1.4.2 The physician shall be able to pause the vital sign readout
- 1.5 Mapping Display
  - 1.5.1 Provide a map with the ambulance displayed at the current location
  - 1.5.2 Provide estimated time of arrival
- 2. DEMS Paramedic's functional area
  - 2.1 Automated Emergency Run Record Management
    - 2.1.1 Provide the paramedic with an outline emergency run record
    - 2.1.2 The run record shall be able to be updated by querying the hospital database
    - 2.1.3 Run records created and modified in this panel are automatically transferred to the Physician workstation
    - 2.1.4 Provide 5 sub-pages for entering information
      - 2.1.4.1 On-Scene:
        - 2.1.4.1.1 Shows patient information and information about the scene and the situation of the emergency
        - 2.1.4.1.2 Provide the ability to swipe a driver's license for patient information input
        - 2.1.4.1.3 The paramedic will be able to switch between patients' forms
        - 2.1.4.1.4 The physician will be restricted to read-only viewing of the run records
      - 2.1.4.2 Examination/Observation:
        - 2.1.4.2.1 Will contain the primary survey of the patient
        - 2.1.4.2.2 The paramedic shall be able to edit the fields in the Examination/Observation page
        - 2.1.4.2.3 Shows a picture based on the information entered; male, female, child, infant
        - 2.1.4.2.4 The paramedic shall be able to identify problem areas by selecting the figure and description in the numbered list
      - 2.1.4.3 Patient HX:
        - 2.1.4.3.1 Shows the background history of the patient

- 2.1.4.3.2 Information obtained by verbal communication with the patient and an upload of the hospital's database
- 2.1.4.4 Patient TX:
  - 2.1.4.4.1 This is a timestamp log of all medications administered to the patient
  - 2.1.4.4.2 Shows what was given, how much was given, and when it was given
  - 2.1.4.4.3 Shall interface with a bar code reader
  - 2.1.4.4.4 Shall be able to customize the display
  - 2.1.4.4.5 Shall be able to manually set the administered time
  - 2.1.4.4.6 Provide area for documentation or comments
- 2.1.4.5 Narrative:
  - 2.1.4.5.1 Provide a free-form text area in which the physician can view the narrative details of the incident scene, transport, treatment and treatment response of the patient
- 2.2 Video Display
  - 2.2.1 Display the images that the Physician sees
  - 2.2.2 The paramedics shall be able to move and zoom the camera
  - 2.2.3 The paramedics shall be able to hear the physician speak
- 2.3 Vitals Display
  - 2.3.1 Display the vitals on the same screen as the video display
  - 2.3.2 Show patients vitals signs in real time
    - 2.3.2.1 Electrocardiogram, leads selectable by physician or paramedic
    - 2.3.2.2 Pulse Oximetry waveform and breathing rate digital information
    - 2.3.2.3 Arterial blood pressure, by waveform or digital display or systolic, diastolic and mean pressures
    - 2.3.2.4 Respiratory rate digital display (and optional waveform)
    - 2.3.2.5 Core body temperature
    - 2.3.2.6 Electronic stethoscope waveform display
- 2.4 Emergency Protocols
  - 2.4.1 Accessible through the vitals display
  - 2.4.2 A web-page-like interface
- 2.5 Mapping and Navigation Interface
  - 2.5.1 Obtain position via GPS
  - 2.5.2 Provide a map with the ambulance displayed at the current location
  - 2.5.3 Provide a map with the travel route to the destination
  - 2.5.4 Provide estimated time of arrival
  - 2.5.5 Provide a zoomed map
  - 2.5.6 Provide a map scrolled in a specified direction
  - 2.5.7 Clear the calculated route on the map
  - 2.5.8 Provide information on landmarks such as schools, hospitals, boundaries, and railroad tracks
  - 2.5.9 Continually read GPS positioning data and update the vehicle's position on the map every second
  - 2.5.10 Show the coordinates of any point specified by a mouse click, which is called geocoding
  - 2.5.11 Searching a place on the map by street address and/or ZIP code
  - 2.5.12 Finding the nearest street to a GPS position (longitude/latitude), which is called reverse geocoding
  - 2.5.13 Compatibility with other map formats
  - 2.5.14 Display maps with zooming, panning, and scrolling functions
  - 2.5.15 Calculate routes and estimate travel time
  - 2.5.16 Add point and shape objects on the map
  - 2.5.17 Report route and estimated travel time to base station once a route is chosen
  - 2.5.18 Show direction of heading
- 2.6 Communications Display
  - 2.6.1 Be able to view and modify parameters affecting data communication to the hospital
  - 2.6.2 Provide a method for automatically determining available bandwidth and reliability of communication mediums at all times and coordinate their usage so as to maximize successful data transmission
  - 2.6.3 Be able to view maximum and actual throughput values of the communication mediums
  - 2.6.4 Be able to change communication parameters
  - 2.6.5 Provide troubleshooting information to the paramedics
- 2.7 Run Record Report

- 2.7.1 Be able to view and modify time-insensitive billing and insurance information
- 2.7.2 The system will automatically save the information when the user switches to a new page and at a timed interval
- 2.7.3 The data will be sent to the hospital only when the paramedic explicitly sends the information
- 2.7.4 Provide 5 sub-pages for entering information
  - 2.7.4.1 Vital Report
    - 2.7.4.1.1 The top half of the screen will show the following: Incident number, Date, Unit number, patient number, Dispatch time, on-scene time, ...
    - 2.7.4.1.2 The bottom half of this screen will be reserved for viewing historical Propaq vitals data
  - 2.7.4.2 Billing:
    - 2.7.4.2.1 Will contain responsible party and insurance information for the patient
    - 2.7.4.2.2 The patient information is automatically filled in
  - 2.7.4.3 Release:
    - 2.7.4.3.1 The patient can acknowledge that medical care was or was not recommended and that he/she is denying care
    - 2.7.4.3.2 This information will be used for legal issues
  - 2.7.4.4 Transport/Crew:
    - 2.7.4.4.1 Contains patient transport method, authorizing physician, and destination of the patient
  - 2.7.4.5 Report:
    - 2.7.4.5.1 Will enable the paramedic to preview or print the entire run record or only selected portions
    - 2.7.4.5.2 The printout will contain all textual data and images from the selected sections in a modular and concise format
    - 2.7.4.5.3 Will emulate many of the run record forms in use today
    - 2.7.4.5.4 Option of printing at the hospital or onboard the DEMS vehicle
- 2.8 Training
  - 2.8.1 Accessible from the onboard computer in the ambulance
  - 2.8.2 Provide emergency procedure training of emergency personnel
  - 2.8.3 Utilize 2D and 3D illustrations, video, and voice
  - 2.8.4 Provide testing and feedback to provide a professional curriculum and meet national standards of the Department of Transportation
  - 2.8.5 Provide case studies of real emergency calls
  - 2.8.6 Provide an on-line medical dictionary
  - 2.8.7 Available at any time

## 6. DEMS System Development Checklist

The list that follows constitutes a checklist of tasks and documentation that must be completed in order to bring DREAMS/DEMS to a successful conclusion.

### 1. DEMS Definition

The Definition Document provides a broad overview of the system, and delineates high level requirements. This document becomes a baseline document, designed to provide guidance throughout the project. The elements of the Definition Document are shown below in the outline.

#### 1.1 Overview/Background

Background of the program, including historical perspectives that will aid in understanding the course of the program's evolution. Overview of how the program should function and integrate. View of benefits to be derived.

#### 1.2 Requirements Summary

A high-level summary of key requirements that must be met in order for the program to be successful. This summary is not devolved to the level of detail of the specific requirements associated with individual subsystems or their components.

1.3 Subsystems

A description of the subsystems associated with the program, and a narrative of how each will inter-operate and function.

1.3.1 Physician's Workstation System

1.3.2 Ambulance

1.3.3 DTS (Deployable Telemedicine System)

1.3.4 Communications Environment

1.4 Project Plan

Delineation of how the project shall be managed administratively, including milestones, timelines, roles and responsibilities, periodic programmatic reviews, and methods of managing changes mandated in the process of review and completion

1.4.1 Target Deliverable Systems

1.4.2 Responsibilities

1.4.2.1 Design Review Team(s)

1.4.2.2 Test Teams

1.4.3 Timeline

1.4.3.1 Design Reviews

1.4.3.2 Change Management System

2. Deliverables

This document identifies, in detail, the various hardware, software, documentation and training elements that must be in place prior to system delivery and acceptance. The specific subsystems are identified and further delineated by their hardware and software components. Interdependence between subsystems and components therein shall be identified by an interoperability matrix. This document also specifies the necessary requirements definitions at the system, subsystem and component levels needed for the overall system to function as designed. The requirements shall serve as a means to judge when the program is near, and at, completion (all requirements have been addressed in the various components, subsystems and overall system). Further, system (and subsystem) testing, requirements-driven, shall be developed, implemented, and satisfactorily completed prior to delivery. Discrepancies discovered in testing shall be addressed and any appropriate corrective steps implemented. Finally, user and administrator documentation shall be prepared and evaluated to establish that the users and responsible administrator do not require constant input from program developers to operate and maintain the system.

2.1 Physician's Workstation System

2.1.1 Hardware

2.1.2 Software

2.2 Ambulance System

2.2.1 Hardware

2.2.2 Software

2.3 Deployable Telemedicine System (DTS)

2.3.1 Hardware

2.3.2 Software

2.4 Communications Environment

2.5 Training

A training plan shall be developed that addresses the routine and administrative operation of the system, and teaches the users and administrators all of the facilities of the hardware and software that may be encountered in "normal" EMS operation.

2.6 Documentation

2.6.1 System Design Document

The System Design Document shall be an overall planning document that incorporates System Requirements (high level requirements), and the development process required to achieve these requirements. Administrative planning detail is addressed in the Definition Document (above) and shall be referenced to that document.

2.6.2 Functional Requirements Document

A Functional Requirement Document ( or a chapter to this document) shall be prepared for each Subsystem, and each component in those Subsystems, specifying the necessary functionality of each Subsystem and component. These Functional Requirements shall be responsive, and referenced to, the System-Level requirements; more specific Functional Requirements may be identified in these sections in order to assure the correct interoperation of the Subsystems in forming the System.

2.6.2.1 Physician's Workstation System

2.6.2.2 Ambulance

2.6.2.3 DTS (Deployable Telemedicine System)

2.6.2.4 Communications Environment

2.6.3 Test Plan

A Test Plan shall be developed and documented. This plan shall address testing and validation using several methods. Testing shall occur in at least two facilities: Software and system testing shall occur in College Station, at the Laboratory designed for this work in Room 608Q of the Blocker Building at Texas A&M University. Medical validation testing, and additional software testing shall occur at the Institute for Biosciences and Technology, in Houston, Texas. Additional testing may be carried out in other, potentially remote settings, including in a deployed facility on the campus of Texas A&M University, or in Liberty County, Texas, under the guidance and supervision of the identified responsible party for such testing.

2.6.3.1 Functional Test Plan

Functional testing shall be developed, documented and implemented using a scenario-based approach which causes operation of all elements of the system in course of normal operation, and further, testing shall be conducted in a linear manner that assures all of the various hardware and software components available are evaluated and provide the expected operation. Both the scenario-based and linear testing shall be referenced back to specific requirements.

2.6.3.2 Medical Validation Test Plan

Medical validation testing shall be developed, documented and conducted to assure that the operation of the system meets the requirements of such medical knowledge, protocols and procedures as needed for the discharge of

normal operation. All medical validation testing shall be referenced back to applicable requirements. Additional medical validation testing may be developed, documented, and implemented to facilitate meeting requirements for certification levied by other organizations and agencies (FDA, etc.).

2.6.3.3 College Station Test Facility ("608Q")

2.6.3.4 Houston Test Facility ("IBT")

2.6.4 User Guide

User Guide documentation shall be developed to serve as a (quick) reference to operation and troubleshooting of the system. The User Guide for each subsystem shall be directed toward the normal users. Operation of each subsystem and each accessible component therein shall be addressed.

2.6.4.1 Physician's System

2.6.4.2 Ambulance

2.6.4.3 DTS (Deployable Telemedicine System)

2.6.5 Administration Reference

An administrator's reference document shall be developed to serve as a detailed reference for the administrator's use in configuring, maintaining, and operating the system. Detailed documentation on the operation and function of the components and subsystems shall be included, with the goal of reducing the number of requests for detailed assistance directed to the developers.

2.6.5.1 Physician's System

2.6.5.2 Ambulance

2.6.5.3 DTS (Deployable Telemedicine System)

## 7. Summary of DEMS Interagency Interactions (Policy & Procedures) Specifications plus Diagrams - Meeting Notes

### TASK 1 - Interagency Interactions (Policy & Procedure) Specifications + Diagrams

- Defining Requirements

We can define a requirement as " a specification of what should be implemented".

There are basically two types of requirements:

- functional requirements – what behavior the system should offer
- non-functional requirements – specific property or constraint on the system

A functional requirement is a statement of what the system should do – it is a statement of system function

NOTE: Use the brainstorming and otherwise design notes from the meetings along with other sources of SOP to establish and document system requirements.

**FUNCTIONAL REQUIREMENT** – what the system should do.

**NON-FUNCTIONAL REQUIREMENT** – a constraint on the system.

- Step 1. Find (Identify) Actors and Use Cases
- Step 2. Detail a Use Case
- Step 3. Structure the Use Case Model

NOTE 1: USE CASE MODELING – a form of requirements engineering

Use Case Modeling involves:

1. Find the system boundary
2. Find the actors
3. Find the use cases:
  - a. specify the use case
  - b. create scenarios

The output from the use case modeling activities is the use case model. There are four components of this model:

1. **actors** – roles played by people or things that use the system;
2. **the cases** – things that the actors can do with the system;
3. **relationships** – meaningful relationships between actors and the cases;
4. **system boundary** – a box drawn around the use cases to denote the edge or boundary of the system being modeled.

Use case model provides a prime source for objects and classes. It is the primary input to class modeling.

- Use the Meeting Notes (Liberty County EMS and June 26, 2002 College Station) along with other SOP sources to establish Use Case and consequently:
  - a) Find the system boundary
  - b) Find(Identify) Actors
  - c) Find Use Cases
    - specify the use case
    - create scenarios

The **System Boundary** is defined by who or what uses the system (DREAMS) (i.e. the **actors**) and what specific benefits DREAMS offers to those actors (i.e. **Use Cases**).

Identify and Diagram Use Case(s)

**Needed Information for Use Case Identification and Modeling:**

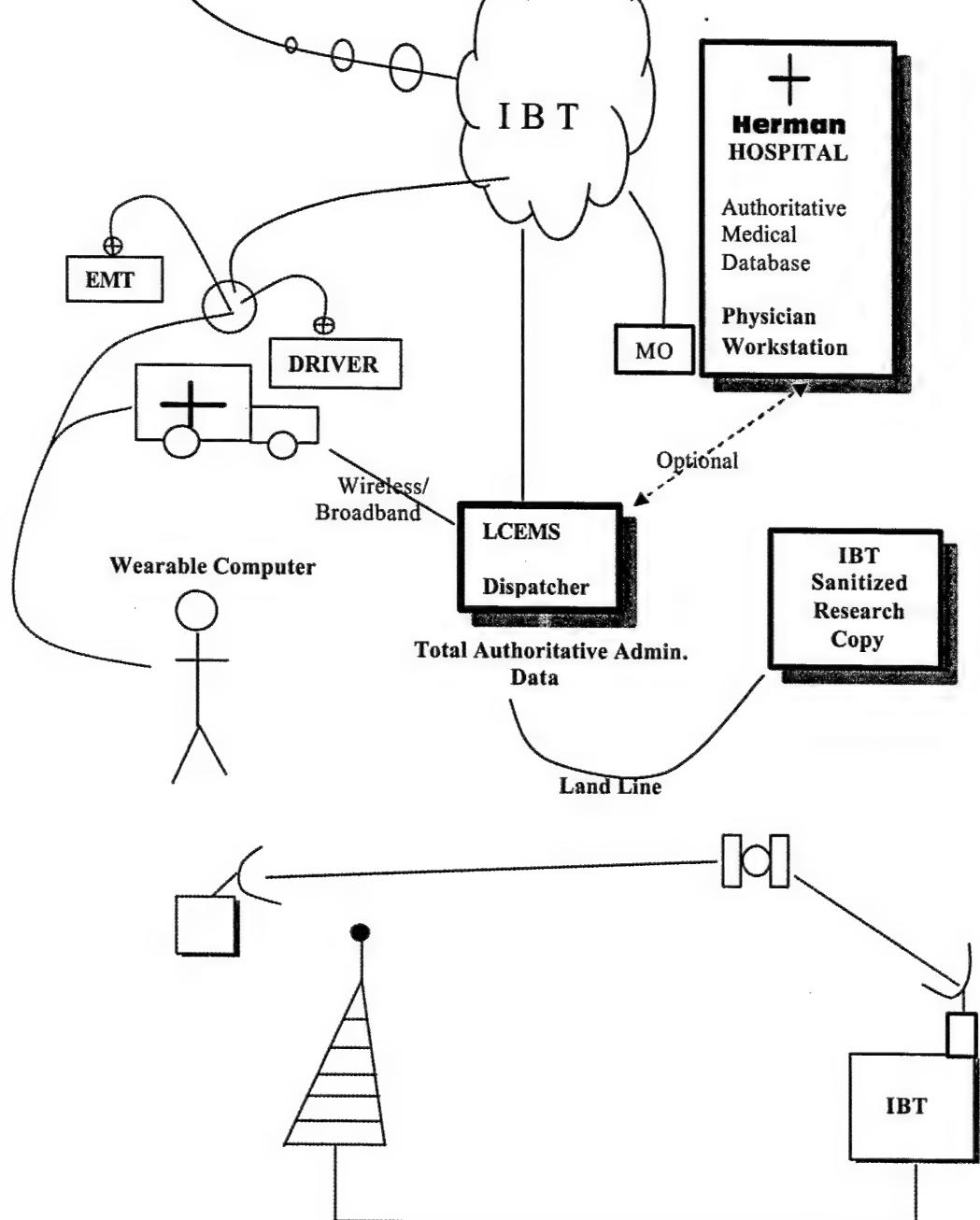
1. **Name of System** – Digital Emergency Medical Service (DEMS)
2. **List of Actors** –
  - a) EMT
  - b) Driver
  - c) Physician (Physician Workstation at Herman Hospital)
  - d) Dispatcher (Liberty County Emergency Medical Service)
3. **Identify DEMS Use Case(s)**

Questions to identify use cases:

- a) What functions will a specific actor want from DEMS?
- b) Does the system store and retrieve information? If so, which actors trigger this behavior?
- c) Are any actors notified when the system changes state?
- d) Are there any external events that affect DEMS? What notifies the system about those events?

Figure 1. Digital Emergency Medical System (DEMS) Components

Deployable Telemedicine System (DTS)



## Re-write/update of Liberty County EMS Meeting Notes

**NOTE:** These notes supports the development of the DEMS Use Case Model

### **BEGIN SHIFT**

Boot up issues

Stop Unit (DEMS) EVERY Stop

- time: 1.5 minutes until up
- shut down cycle: 3 minutes
- power up: power boot scripting, to bring OS and DEMS system up
- power controller may lengthen time to be ready to use

Login: Shift start. In back 4 medics, 2 in and 2 out

- at card swipe => login/logout screen
- card + PIN => x 2 crew members

For Individual Run: Medics already logged in

- new record/patient pull down menu: choose name, enter PIN, + "card"
- change initial signature if patient condition changes

Mirroring information to Medic not with patient FYI

SOP: cards MUST be carried

SOP: COMPLETE ALL RECORDS BEFORE SHIFT LOGOFF

### **INCIDENT**

Call – Pager goes off

**Unit off**

1. Key truck, generator on  
**Magic Button – Start DEMS**
2. Drivers Station to map/GPS – allow input of destination and Dispatch time
3. Back comes to blank Run report  
Non-normal Shut Down Restart:  
Blank Record? Or Lost Record?  
Barcode scan

## **DISPATCH**

Riding Medic enters  
Destination

Drive en-route  
Hit en-route button

## **AT SCENE**

Log time on scene  
Mileage

Grab: Drug bags, propaq, and gurney  
Get Patient:

Treat Patient in place  
Take back to ambulance  
Load into ambulance

## **PATIENT IN AMBULANCE**

Sign patient refusals (paper only)

Propaq on patient  
Hook into vehicle  
Lead Medic Signs in:  
Barcode/pswd

Start, modify, view:  
Patient record

Patient Treated:  
IV, O<sub>2</sub>, blood, airway  
Call Life Flight, medcon (medical control)

## **EN ROUTE**

Enroute time  
Mileage

Continue treatment / monitoring

Update patient information

## **DESTINATIONS**

1. Community (no calls to HH)
  - a. HH contact => transport to community
2. HH by ground
3. HHLF
4. Life Flight to other Hospital

## **INCOMPLETE RECORDS**

Automatic Sync:

At Physician work station  
Every time it's available

## **HOSPITAL/LZ(Loading Zone if Life Flight)**

Time Out at H / LZ (transfer of patient time)

Mileage at H / LZ

1. Transfer to hospital  
Complete run record  
Possibly deferred
- 1a. Transfer  
Complete  
Possibly deferred (to Community H + HH)
2. Transfer  
Complete records
3. Transfer "By voice"  
Transfer records to HH  
Complete records
4. Transfer  
Complete  
Possibly deferred (to Community H + HH)

## **LIFE FLIGHT**

On Scene time

Leave scene time

## **LOGOFF/SHIFT CHANGE**

Swipe card

If reports finished

Allow logoff

Reports unfinished

Prompt to complete

Final versions of reports queue to transfer

- LCEMS billing
- HH medical
- Research data to repository
- Community hospital medical

# Summary of Technical Meeting Held at TEES, 2002-06-26

## CONCEPTS / DATA REPRESENTATION / INFORMATION MODEL ISSUES

1. Patient data should be patient-encounter-centric not incident-centric. This means that we will have to use some type of derivable number to uniquely identify the specific patient encounter
2. All stored data must support full audit trails
  - a. Revision number
  - b. Revision time
  - c. Who revised
  - d. Record of past values and times
3. All data records must have the following
  - a. Unique record ID
  - b. Link back to unique patient ID & incident ID
  - c. Unique name and code to define each concept in the record
  - d. Value (text, integer, float, Boolean, array of numbers, code)
  - e. Clinical Valid-From timestamp (time the value was obtained, blood sample was drawn, time medication was given, etc.)
  - f. Clinical Valid-Until timestamp (principally used for tracking edited values)
  - g. System Valid-From timestamp (time record was committed to DB)
  - h. System Valid-To timestamp (for edited value, the time the edit was committed)
  - i. Revision number
  - j. Data authorization ID (ID number of person/device who clinically authorized the data)
  - k. Commit authorization ID (ID number of person / device who authorized the commit to the DB)
4. All data elements must be cross-referenced to master concept data dictionary
5. The data elements present on the Liberty County EMS run sheets and LCEMS medical protocols and SOPs will be used as the source for the concept data dictionary.
6. All concepts present on the existing LCEMS run sheets, medical protocols, and SOPs will be available in the DEMS EMT Station and Physician Station software.
7. Functions to access the data will be developed, if not already extant. Both basic data retrieval and abstraction functions will be required.

**The above Issues 2 – 6 were agreed to in the meeting. Issue 1** came up after the meeting adjourned during the review of Kevin Gupton's database diagram.

UTHSCH will provide to TAMUS a data dictionary of all of the concepts contained in the LCEMS run sheets, medical protocols, and SOPs. Data dictionary will include: concept id number, concept name (short), concept name (long), concept definition, reference name, reference name source, type of value (text, integer, float, coded, etc.), normal, abnormal, critical, and absolute ranges (where appropriate), is it a repeated measure, and the units of measure to be used (where appropriate).

UTHSCH will work with TAMUS to create one or more information models to represent the clinical and non-clinical information about each patient care encounter (this includes the incident information, vehicle information, administrative information, and patient-care information). These information models will be used to instantiate a database, provide an intellectual model for use when designing and discussing patient care and clinical decision support, provide a foundation for data interchange functions.

TAMUS will instantiate the data model in a manner that meets the clinical data needs of the physicians, EMTs, and provider-extenders (e.g., medical protocols). Instantiation may be in the form of a database.

TAMUS will develop APIs to the instantiated data model to meet the medical data storage and retrieval needs. UTHSCH will provide a list of the needed functions.

## **“BIRTH AND DEATH OF DATA”**

A long discussion about the birth and death of data resulted in the following agreements.

1. During a patient treatment / transport encounter (“ambulance run”), the authoritative record of the patient encounter exists on-board the ambulance. This is a working copy of the encounter record.
2. One or more partial or complete working copies may exist in other locations such as the physician’s workstation, the receiving facilities emergency department, or the emergency medical service’s office
3. Once a record has been “signed” for closure on-board the ambulance, no further edits may be made to the record. Once signed the record is marked “signed” and is tagged for upload to the master authoritative data repository at the emergency medical service’s office.
4. The medically relevant portions of the encounter record will be extracted into an HL7-compliant message, encrypted, and transmitted to both the hospital that received the patient and the hospital where the physician’s workstation is located (this latter process only occurs when a mentoring request occurs during the treatment/transport).
5. Working and signed encounter records may be maintained on the ambulance if the records have either not been completed or when communications pathways to upload the data have not been available.
6. A simplified state diagrams for the transition is shown in table 1.

**Table 1 State Diagram for Encounter Records**

Time/state ↓	Ambulance	MD Workstation	Rec. ED	Rec. Hospital	MD Hospital	EMS Office
Shift Start	W*   S*   Ø	Ø	Ø	Ø	Ø	Ø
On Station	W*   S*   Ø	Ø	Ø	Ø	Ø	Ø
Dispatch	W*   S*   Ø	Ø	Ø	Ø	Ø	Ø
New Patient	W+	Ø	Ø	Ø	Ø	Ø
On Scene	W+	W+   Ø	W+   Ø	Ø	Ø	Ø
Treat/ X-port	W+	W+   Ø	W+   Ø	Ø	Ø	Ø
Drop Off	W+	W+   Ø	W+   Ø	W+   S*	Ø	Ø
Stock / Clean	W+	Ø	Ø	W+   S*	Ø	Ø
Shift End	W+   S*   Ø	Ø	Ø	W+   S*	Ø	S+   Ø
∞	W*   Ø	Ø	S+	S+	S+ (opt).	S+

W == working copy of encounter record, S == signed copy of encounter record

+ == 1 or more, \* == 0 or more, Ø == null or empty set, | == selection or choice

So W+ | Ø == one or more working encounter records or no records. This is distinct from zero or more working encounter records.

In this state diagram, any previous working or signed records are ignored from the “NewPatient” state on down.

## USABILITY ISSUES

Much discussion about how to distinguish between an edit and a new record event and how to “sign” or authenticate individual data elements occurred. As a first pass, we agreed that a “sign” button would be added to each page or section of the charting screens. Data elements could be freely edited and changed, but the “sign” button would have to be pressed or clicked to save the data. Any changes to signed fields where the event times did not change would be classified as an edit. Where the event time changed, it would be classified as a new record. We still need to work on how to do some of the event times behind the scenes.

### Identifying and Modeling Actors

**Name of System –** Digital Emergency Medical Service (DEMS)

**List of Actors –**

- e) EMT (EMT<sub>1</sub>)
- f) Driver (EMT<sub>2</sub>)
- g) Physician (0 or More) (Physician Workstation at Herman Hospital)
- h) Dispatcher (Liberty County Emergency Medical Service)

**Identify Use Case(s)-** Emergency Incident

Identify the actors by considering who or what uses the system (DEMS), and what roles they play in their interactions with the system.

In terms of modeling actors, remember the following points:

- Actors are always external to the system – they are outside of the software Developer's control
- Actors interact directly with the system – this is how they help to define the system boundary
- Actor represent roles that people and things play in relation to the system, not specific people or specific things
- One person or thing may play many roles in relation to the system simultaneously or over time.
- Each actor must have a short description (one or two lines) that describes what this actor is from a business perspective.
- Likes classes, actors may have compartments that show attributes of the actor and events that the actor may receive.

**List of Actors –**

- i) Crew (EMT<sub>1</sub>)
- j) Driver (EMT<sub>2</sub>)
- k) Physician (0 or More) (Physician Workstation at Herman Hospital)
- l) Dispatcher (Liberty County Emergency Medical Service)

Short description of each actor:

EMT<sub>1</sub> : Crew EMT on Dispatched Ambulance

EMT<sub>2</sub> : EMT that drives the Dispatched Ambulance

Physician: Emergency Medical Operations Physician On Call  
At Herman Hospital

Dispatcher: Liberty County Emergency Medical Service Dispatcher On  
Duty

**Development of a Candidate List of Use Cases**

**Name of System** – Digital Emergency Medical System (DEMS)

**List of Actors –**

- m) EMT
- n) Driver
- o) Physician (Physician Workstation at Herman Hospital)
- p) Dispatcher (Liberty County Emergency Medical Service)

**Identify Use Case(s)**- Use Case1 - Emergency Incident

Use Case2 –

Use Case3-

The best way of identifying use cases is to start with the list of actors, and then consider how each actor is going to use the system (DEMS).

Each use case must be given a short, descriptive name that is a verb phrase – after all, the use case is *doing* something!

## **CALLS REPORTABLE TO LAW ENFORCEMENT AGENCIES (LCEMS requirement)**

Employees who are responding to a call that may need law enforcement involvement such as gunshot wounds, stabbing, or other acts of violence should report such incidents immediately to the proper authorities. If knowledge of a violent scene is available before arriving at the scene the employee's should proceed toward the scene but remain at a safe distance until notified by the proper authorities that the scene is secure. Employees should ensure that all responders remain at a safe distance by notifying dispatcher to inform all responders of such until proper authorities have the scene secure. Employees should ask that the authorities remain on scene until patient care can be obtained and unit leaves the scene.

Employees responding to a call that may be suspect to child abuse should notify Child Protective Services as soon as possible. In the event that they are not available at their office the S.O. has a schedule of on-call workers and may be asked to notify available persons on call and for such person to return call so that the incident may be reported.

### **SOP – Call Reportable to Law Enforcement**

**Matt – Should this be included in DEMS??**

Laurie --- Does not seem to alter DEMS activities!!!

## **Minimum Functional Requirements for DEMS Hardware and Software Systems**

### **I. DEMS System (General)**

- a. DEMS installations (an installation consists of either an ambulance software/hardware package, a DTS, a rural ER hardware/software package, or a physician workstation) shall be started from a "cold" (i.e. hardware and turned off) state with a single button push.
- b. DEMS installation software shall be restarted if necessary from a single application, batch file, or shortcut
- c. No display other than the GUI shall be presented to the user during either the starting or stopping of the DEMS software.
- d. All DEMS software shall require a token and pin/password or two token authentication before it can be used.
- e. All DEMS software shall support multiple simultaneously logged in users with assigned roles
- f. All DEMS software shall support multiple simultaneously logged in users with designations of active and inactive
- g. All DEMS software shall support changing the currently active users on the fly.
- h. All DEMS software shall support changing the roles of the currently active users on the fly
- i. After patient records have been "signed", the records shall be queued for automatic transmission to a base station.
- j. All unsigned and not currently active patient records shall be backed up to a base station if a broadband connection to the base station is available once all signed records have been transferred.
- k. Unsigned records transferred to a base station shall be maintained until a signed record is transmitted to the base station.
- l. DEMS systems shall support the reloading of unsigned records into remote systems (non-physician workstation units) from the base station in the case of catastrophic storage failure on the remote stations.
- m. The authoritative copy of the patient record shall be the copy on the remote system until the record is signed, transmitted, and acknowledged by a base station.
- n. Once a patient record has been signed and successfully transferred to a base station, the authoritative copy of the record shall be the copy at the base station.
- o. Once the authoritative copy of a patient record has been transferred to a base station, a copy shall be maintained on the remote system for a period not to exceed 48 hours. This will help insure against data loss due to catastrophic failure of base station computer hardware.
- p. Base station computer hardware shall contain hardware RAID or other hardware-based hard drive mirroring
- q. Base station computer hardware shall support scheduled, automated backup systems.

### **II. Concepts / Data / Information**

- a. Patient data shall be patient-encounter-centric not incident-centric.
- b. All stored data shall support full audit trails
  - i. Revision number
  - ii. Revision time
  - iii. Who revised
  - iv. Record of past values and times
- c. All data records shall have the following

- i. Unique record ID
- ii. Link back to unique patient ID & incident ID
- iii. Unique name and code to define each concept in the record
- iv. Value (text, integer, float, Boolean, array of numbers, code)
- v. Clinical Valid-From timestamp (time the value was obtained, blood sample was drawn, time medication was given, etc.)
- vi. Clinical Valid-Until timestamp (principally used for tracking edited values)
- vii. System Valid-From timestamp (time record was committed to DB)
- viii. System Valid-To timestamp (for edited value, the time the edit was committed)
- ix. Revision number
- x. Data authorization ID (ID number of person/device who clinically authorized the data)
- xi. Commit authorization ID (ID number of person / device who authorized the commit to the DB)
- d. All data elements shall be cross-referenced to master concept data dictionary
- e. All concepts present on the existing LCEMS run sheets, medical protocols, and SOPs will be available in the DEMS EMT Station and Physician Station software.
- f. Functions to access the data will be developed, if not already extant. Both basic data retrieval and abstraction functions will be required.
- g. A clinical data dictionary shall be created that includes all clinical concepts (data elements) present on the Liberty County EMS run sheets, LCEMS medical protocols and SOPs.
- h. The data dictionary of concept definitions will define the following:
  - i. Concept name
  - ii. Concept number
  - iii. Concept definition
  - iv. Data type – coded, numeric, text, Boolean, etc.
  - v. Units, if appropriate
  - vi. Reference ranges – ‘normal’, abnormal, critical, absolute
  - vii. Valid codes, if concept is a coded value
- i. The data dictionary will define concepts as they are represented clinically. Physical storage of the data values for the concepts may be in alternate forms as long as the database I/O routines accept and return data using the appropriate data type.
- j. DEMS software / GUI shall support both creating new records and the editing of existing records.

### III. Usability

#### a. General principles

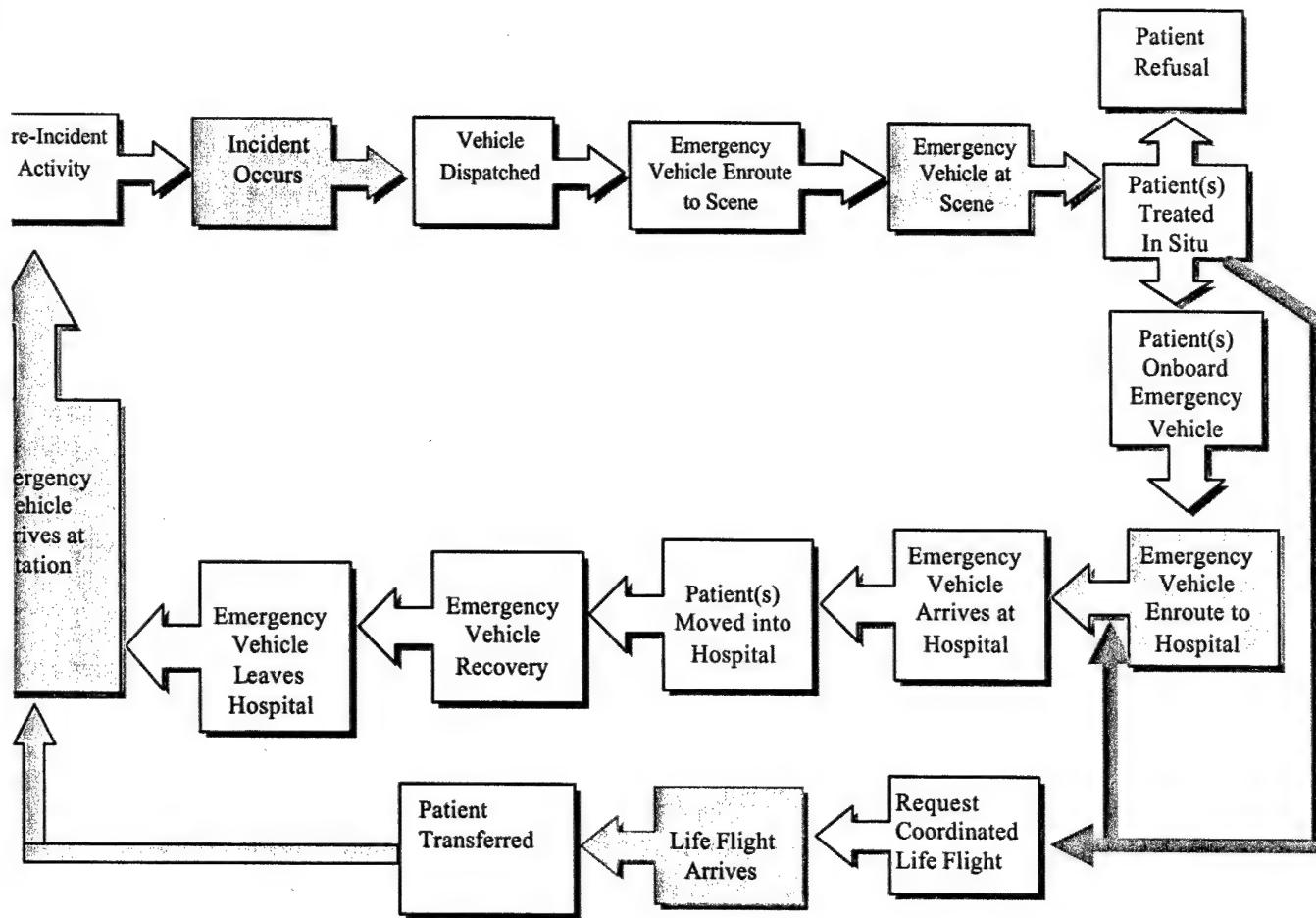
- i. All clinical functions of system must be operable by a multiple modes of interface (e.g., touchscreen and keyboard, or touchscreen, keyboard, and tablet)
- ii. All clinical functions must be fully accessible from any single input device with simple, one button, either keyboard or mouse, access (i.e., no “shift-click” or “ctrl-alt-right click” combinations for clinical functions.)
- iii. Purely technical commands, such as checking status of power Controller, may have access limited by using key chords.
- iv. Information and data presented to clinical users must be presented

in a manner that is similar, if not identical, to the manner that is routinely presented to them. For example: blood pressure should be represented as “120/70” no “SBP: 120, DBP:70”.

- v. Information and data presented to clinical users must be presented in a manner that allows clinical users to recognize important data.
- b. More details to follow based on the SHIS evaluation and feedback from physicians.

## Questions to Answer for Liberty County Deployment

- How is a physician (at Herman) notified when assistance is required by Ambulance?
- Where does the emergency run-record end up?
  - Does it end up as a paper copy to file? Soft Copy?
  - Does the physician need to write to it? (he currently can't)
    - If so, does the hospital record need to synch to ambulance?
  - Where does the stripped down (no patient indicators) run record get stored for further processing?
    - How does this database get created?
    - Only found on ambulance? Hospital? Both?
  - Are refusal records also stored?
  - If remote physician is not needed anymore, doe additions to the run-record  
Need to be synched with record at hospital?
- When does the local database get accessed? When the run record is created?  
Finished? All the time?
- What other information (apart from run record info) needs to be stored in the database?
  - Vital Signs? (All or 6 second chunks)
- How will video get stored?
- How do paramedics initiate the system?
  - How do they log into the system?
  - How are their "signatures" attached to procedures on the patient.
- How do paramedics log out of the system?
  - How is the system shut down?
- Should the physician determine and tell the system how much communication resources he requires? (e.g. Does the physician need to tell the system that he needs video? Audio? Etc.?)
- Are wearable computers to be deployed?
  - What functionality will they support?
- How do we match vital signs from the monitor to a patient when there are more than one(1) patient on the ambulance?
- \* When system loses connection, how is it reestablished to Hospital?
  - Re-sending notification? Automatically?
- Is the web training system to be included?



### **DREAMS Actors**

- \* Dispatcher
- \* Patient
- \* Lead Medic  
(Paramedic)
- \* Subordinate Medic(s)  
(Basic or Intermediate)
- \* Doctor at Hospital
- Receiving Physician
- \* Administrators
  - EMT
  - Workstation hospital
  - Receiving Hospital
  - Systems Administrator
- \* Researchers

## DREAMS TRANSPORT OPTIONS

- PATIENT REFUSAL OF TRANSPORT
  - \* Less than urgent injury — Community Hospital
  - \* Emergency injury — Community Hospital
- PATIENT REFUSAL OF MEDICATIONS
  - \* Emergency injury — Tertiary Care Facility  
(Life Flight not available)
  - \* Emergency injury — Life Flight (on scene)
  - \* Emergency injury — Life Flight (rendezvous)
  - Patient transfer
  - Triage

Note: Administrator list: Mileage (validity)  
In / Out service  
Inventory

## DREAMS

- \* Types of Injuries
  - Routine
  - Urgent
  - Emergent
- \* DREAMS Specific
  - Request Trauma Support Physician
  - What if we have designated comm zone?
- Other
  - Scan Driver's License
    - Modify or Add New
    - Test group w/Smart Cards
    - 2D Bar Code
  - Printer
- \* Contingencies [SOP]
  - Triage

### DREAMS Ambulance Procedures

#### Start Ambulance Start Shift

- boot system

- \* log into system
  - check truck (vehicle)
  - check equipment
  - check medications (inventory)
- wash vehicle
- shift briefing

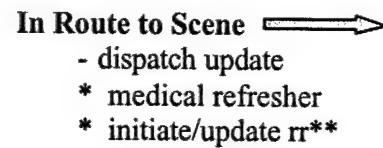
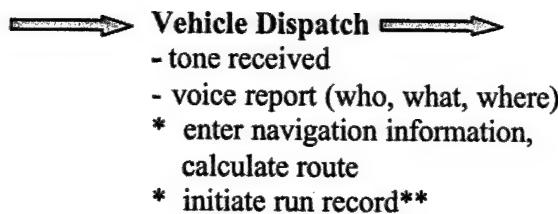
} may want  
to add to  
system

- \* system check

Note: \* DREAMS specific

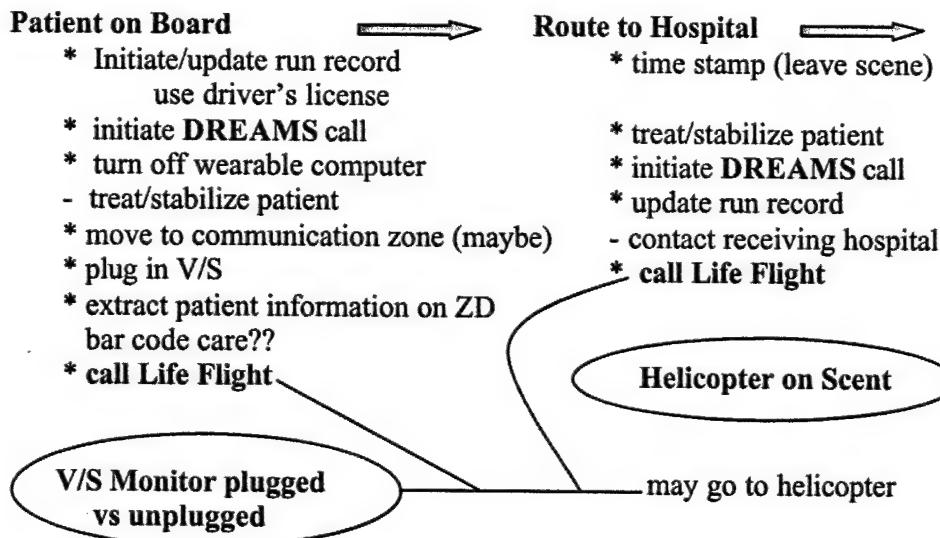
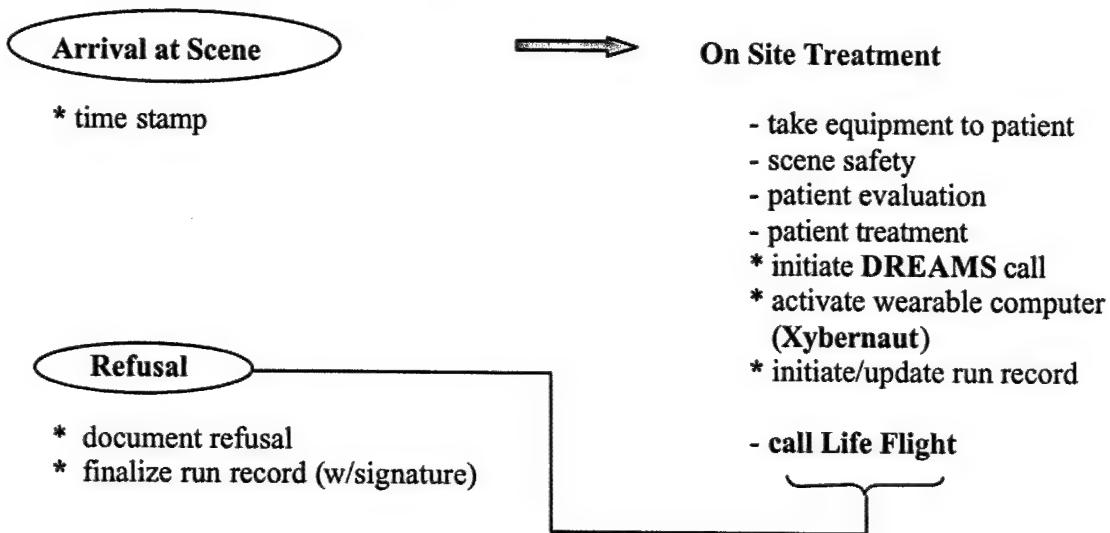


- \* Web-based training (not for Liberty)
- staff meetings
- administration staff
- \* communication check

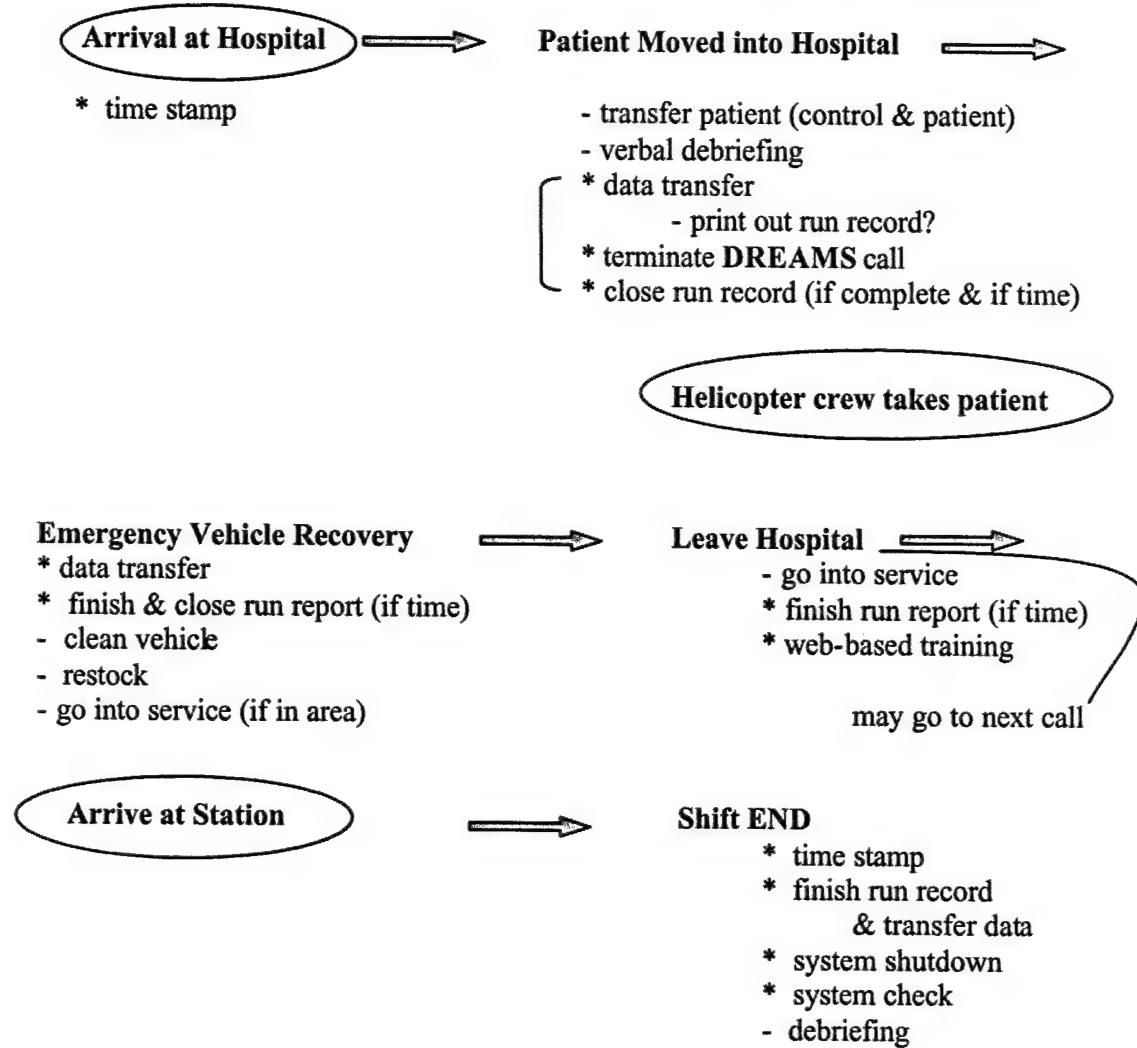


Note: \*\* can be done at other stages

### DREAMS Ambulance Procedures(continued)

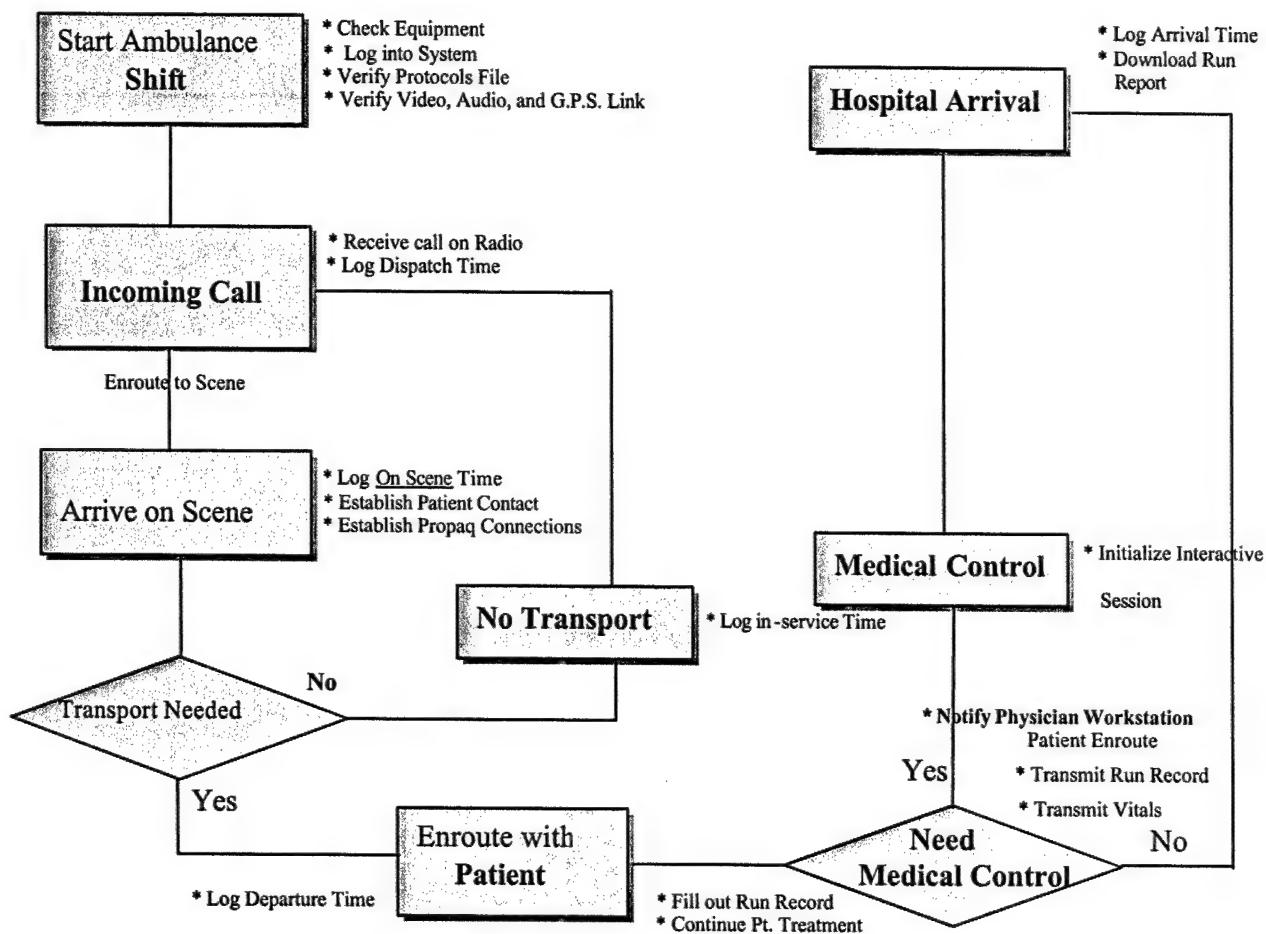


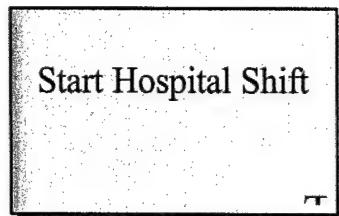
## DREAMS Ambulance Procedures(continued)



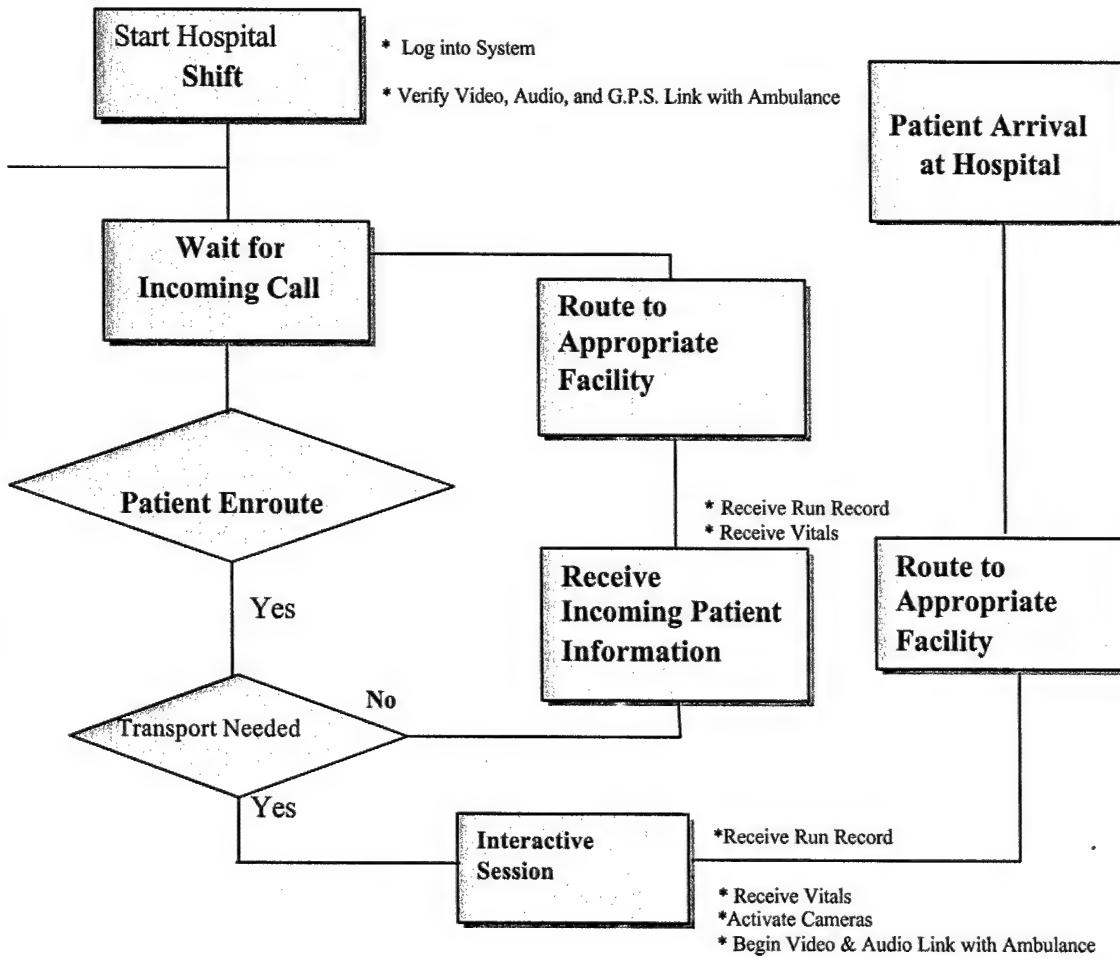
## Start Ambulance Shift

- Update Briefing from Out-going Crew
- Perform Radio Check with Dispatch
- Check Truck
- Check Standard Medical Equipment
- Boot System
- Crew Log into System for Run Record
- Verify Protocols are Operational
- Run Propaq Diagnostic
- Initialize Connection with Hospital
- Verify Video Transmission and Camera Operation
- Verify Audio Transmission and Clarity
- Verify G.P.S. Program Operational





- \* Boot System
- \* Log into System
- \* Initialize Connection with Ambulance
- \* Verify Video Transmission and Camera Operation
- \* Verify Audio Transmission and Clarity
- \* Verify G.P.S. Program Operational

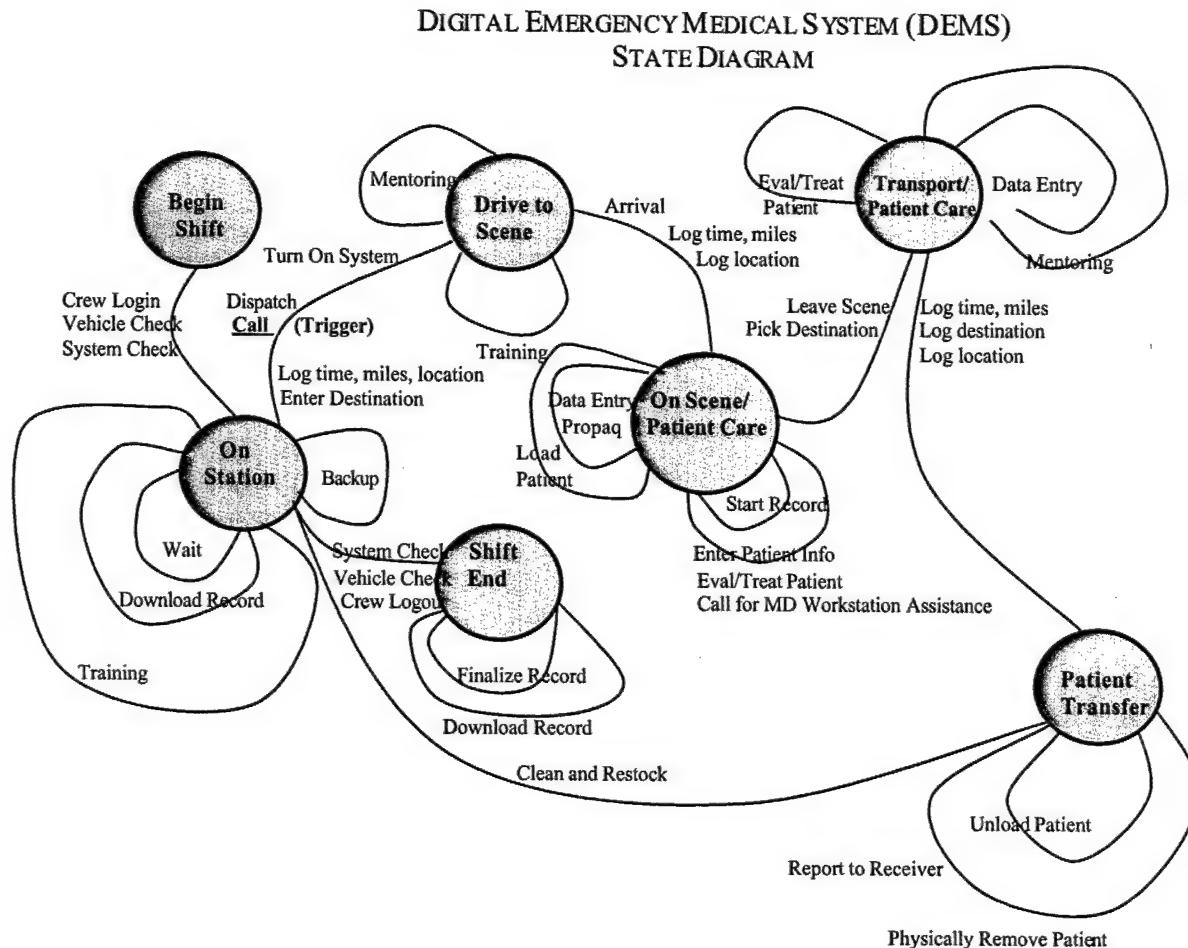


List of Use Case Scenarios  
(Short Descriptive Name that is a verb phrase)

1. Emergency Response(ER) to Chest Pain (**ER\_ChestPain**)  
(business or home) => local community hospital for stabilizing)
2. Emergency Response(ER) to Slip & Fall (**ER\_Slip&Fall**)  
(broken leg – simple fracture)
3. Emergency Response(ER) to Industrial Accident (**ER\_IndustrialAccident**)
4. Emergency Response (ER) to Automobile Accident (**ER\_AutoAccident**)  
(2 Patients both trauma – die within an hour)
5. Emergency Response (ER) to Acts of Violence (**ER\_Acts-of-Violence**)

## 8. DEMS UML Diagrams

## 8.1 DEMS State Diagrams

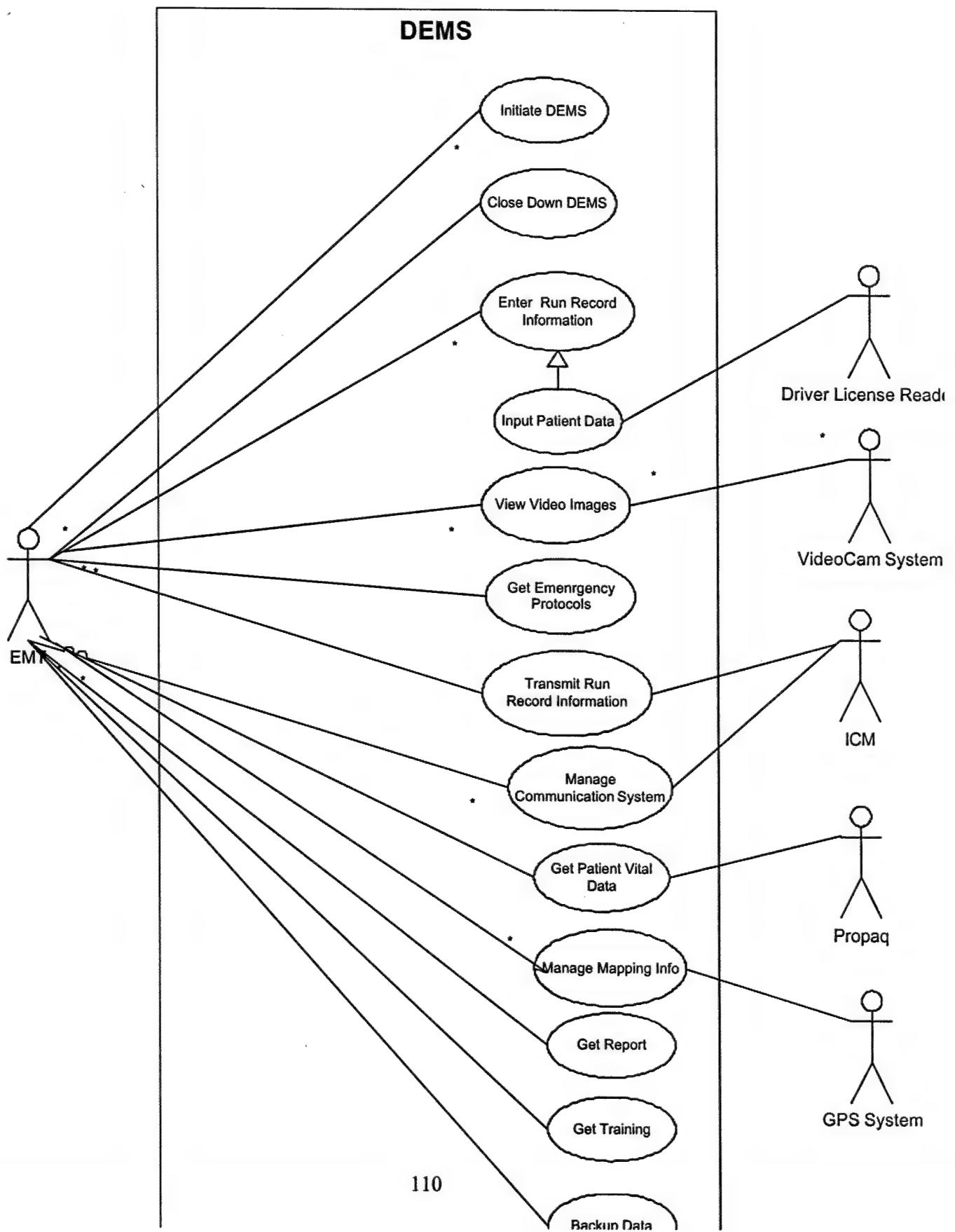


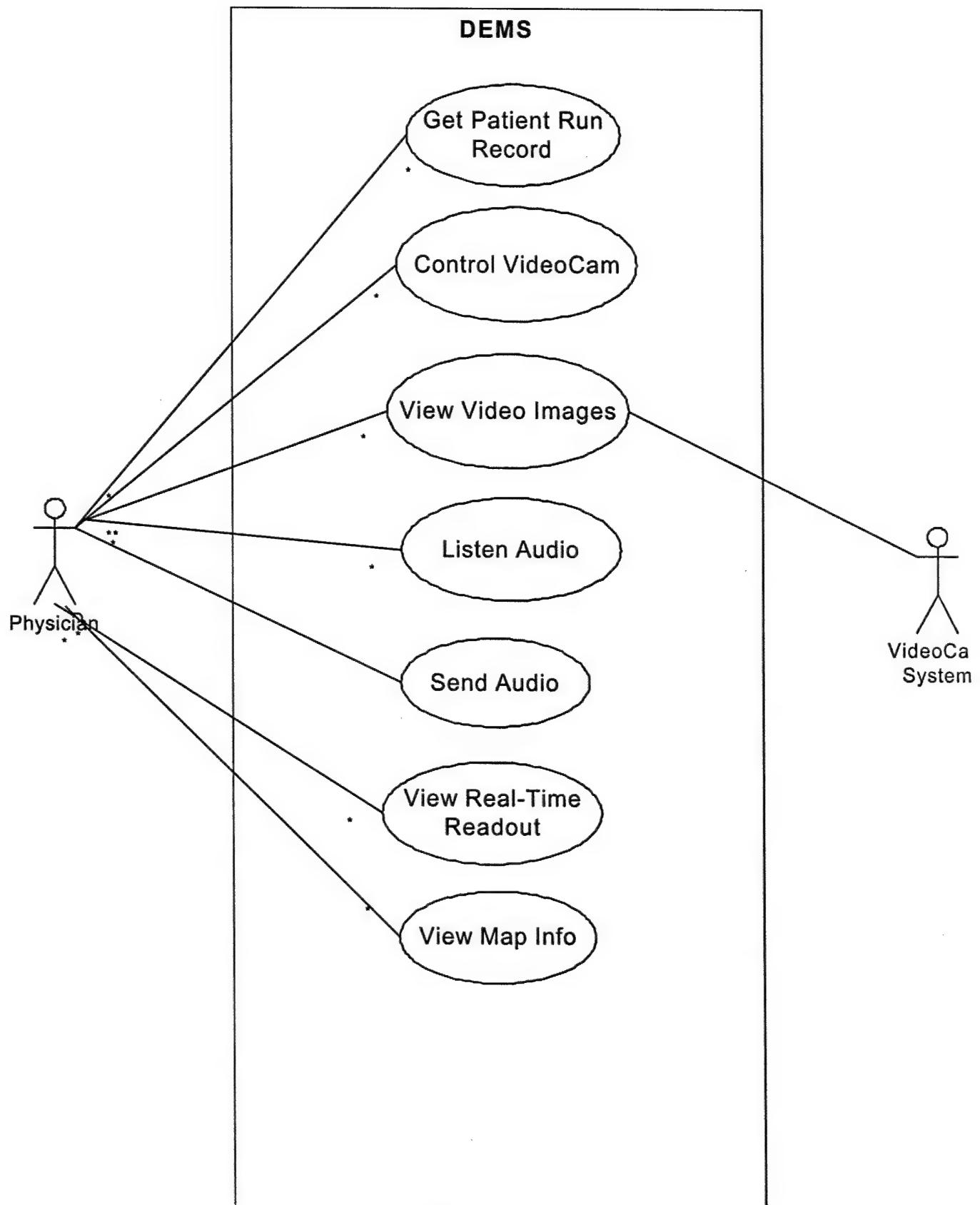
## 8.2 DEMS Use Case Diagrams

Use case diagrams are developed for the two actors interacting with DEMS:

- a. EMT(s)
- b. Physician Workstation H-H

### 8.2.1 EMT Use Case Diagram





### 8.3 DEMS Use Case Specifications

#### 8.3.1 DEMS Use Case Specifications for Actor Physician Workstation H-H

Use Case: Manage Patient Run Record	
ID:	
Actor(s):	Physician Workstation H-H EMT
Preconditions:	<ol style="list-style-type: none"> <li>1. EMT initiate Run Record upon arrival On Scene</li> <li>2. EMT transmit Run Record (Request Assistance)</li> <li>3. DEMS operational</li> </ol>
Flow of Events:	<ol style="list-style-type: none"> <li>1. The Use Case starts when the "Run Record" (On Scene Page, Exam Observation Page, etc.) arrives at the Physician Workstation H-H "Interact" Window. Physician press the "On-Scene" button. Physician selects "Run Record" button.</li> <li>2. DEMS displays the run record.</li> <li>3. The Physician selects patient for observation from a list of patients currently stored in DEMS             <ol style="list-style-type: none"> <li>3.1 The Physician press a small arrow button on the border of the "Interact" Window</li> <li>3.2 Physician selects patient from pop-up list</li> </ol> </li> <li>4. Physician chooses the patient's forms (Exam Observation, Patient HX, etc.)</li> <li>5. DEMS displays the form corresponding to the selected tab with updated information</li> <li>6. If the Physician selects the Narrative tab and enters information in the form             <ol style="list-style-type: none"> <li>6.1 DEMS accepts the information entered by the Physician</li> </ol> </li> <li>7. Telestrator function relayed to EMT station and not stored.</li> </ol>
Postconditions:	

Use Case: Control Video Camera	
ID:	
Actor(s):	Physician Workstation H-H Video Camera System
Preconditions: DEMS Started	
Flow of Events:	<ol style="list-style-type: none"> <li>1. The Use Case starts when Physician select video/vitals button</li> <li>2. DEMS display camera view and camera control buttons             <ol style="list-style-type: none"> <li>2.1 Physician select camera</li> <li>2.2 DEMS indicate which camera selected</li> </ol> </li> <li>3. Physician selects direction/zoom buttons to orient/zoom camera</li> <li>4. DEMS orient/zoom the camera accordingly and displays view</li> </ol>
Issues: Bandwidth => Frame rate; "Quality" .... Or video/stills "Physician override or data priority"	
Postconditions:	<ol style="list-style-type: none"> <li>1. The selected camera positioned according to Physician's selections</li> </ol>

Use Case: View Video Images	
ID:	
Actor(s):	Physician Workstation H-H EMT
Preconditions:	1. Sufficient Bandwidth
Flow of Events:	
<ol style="list-style-type: none"> <li>1. This use case starts when Physician selects video/vitals button</li> <li>2. Physician selects "camera control" button           <ol style="list-style-type: none"> <li>2.1 DEMS provides full rotation control of cameras to view different video aspects of patient</li> </ol> </li> <li>3. Physician selects "zoom control" button           <ol style="list-style-type: none"> <li>3.1 DEMS provides full zoom control of cameras to view different video aspects of patient</li> </ol> </li> <li>4. DEMS provides Physician's-Eye view of a patient in the Interact™ Ambulance</li> </ol>	
Postconditions:	
1. DEMS displays the view Physician selects	

Use Case: Listen to Audio

Use Case: Record Audio

Use Case: View Real-Time Data-Vitals
ID:
Actor(s): Physician Workstation H-H EMT
Precondition: EMT connects Propaq Vitals Sign Monitor enabling real-time patient vitals sign display, monitoring and transmission
Flow of Events: <ol style="list-style-type: none"> <li>1. This Use Case begins when Physician selects video/vitals button</li> <li>2. DEMS displays the "Exam/Observation" Page containing             <ol style="list-style-type: none"> <li>2.1 ECG real-time                     <ol style="list-style-type: none"> <li>2.1.1 Physician Select Leads</li> </ol> </li> <li>2.2 Pulse oximetry waveform real-time</li> <li>2.3 Breathing rate digitally</li> <li>2.4 Arterial blood pressure                     <ol style="list-style-type: none"> <li>2.4.1 Arterial blood pressure waveform/digital</li> </ol> </li> <li>2.5 Respiratory rate digitally/waveform</li> <li>2.6 Core body temperature</li> <li>2.7 Electronic Stethoscope waveform</li> </ol> </li> <li>3. DEMS pause vitals signs real-time display at Physician's request</li> </ol>
Postconditions: <ol style="list-style-type: none"> <li>1. DEMS displays the patient's vital sign data in real-time</li> </ol>

<b>Use Case: View Map Information</b>	
ID:	
<b>Actor(s):</b>	Physician Workstation H-H
<b>Preconditions:</b>	DEMS operational, G.P.S. link active
<b>Flow of Events:</b>	<ol style="list-style-type: none"> <li>1. This Use Case begins when the Physician selects the Map button</li> <li>2. DEMS display a Map with the "Interact™" Ambulance displayed at the current location and G.P.S. coordinates within 30 seconds</li> <li>3. DEMS display estimated time of arrival</li> <li>4. DEMS displays destination address</li> <li>5. DEMS displays the recommended route (available but normally turned off)</li> </ol>
<b>Postconditions:</b>	<ol style="list-style-type: none"> <li>1. DEMS displays the current location of ambulance and related data</li> </ol>

### 8.3.3 DEMS Use Case Specifications for EMT(s)

<b>Use Case: Initiate DEMS</b>
ID:
<b>Actor(s):</b> EMT(s)
<b>Preconditions:</b> DEMS operational
<b>Flow of Events:</b> 1. EMT pushes the start button 2. System boots 3. System prompts for login
<b>Alternative Flows</b> 1. System hangs while booting 2. EMT presses the start button again
<b>Postconditions:</b> 1. DEMS is initiated and ready for EMT(s) login

<b>Use Case: Close Down DEMS</b>
ID:
<b>Actors:</b> EMT(s)
<b>Preconditons:</b> DEMS operational
<b>Flow of Events:</b> 1. EMT presses the shut-down button 2. DEMS shuts down
<b>Alternative flow:</b> 1. Power goes out.
<b>Postconditions:</b> 1. DEMS shut down

Use Case: Enter Run Record Information	
ID:	
Actors: EMT(s)	
Preconditions: DEMS operational (on)	
<p>Flow of events:</p> <ol style="list-style-type: none"> <li>1. EMT presses Run Record button</li> <li>2. DEMS provides EMT with an online new Emergency run record</li> <li>3. DEMS displays newly created Run Record</li> <li>4. DEMS activate link to hospital database facilitating run record update via database query Optional: May also contact EMS Provider Database</li> <li>5. DEMS transfer to Physician Workstation H-H all created and modified Run Records automatically (on a time interval as a function of Bandwidth quality) only if "Mentoring" is taking place</li> <li>6. DEMS provides EMT(s) multiple pages (On-Scene, Exam/Observation, etc.) for entering information</li> <li>7. EMT selects tab for which he wants to enter information</li> <li>8. DEMS displays form corresponding to selected tab</li> <li>9. EMT enters information in form displayed (Keyboard, Mouse, Touchscreen, Signature Pad, Magnetic Stripe Recorder, etc.)</li> </ol> <p>Alternative flow:</p> <ol style="list-style-type: none"> <li>1. EMT selects run record</li> <li>2. DEMS open selected run record for editing</li> <li>3. EMT selects tab to enter information</li> <li>4. DEMS displays form corresponding to selected tab</li> <li>5. EMT enters information in form displayed</li> </ol>	
<p>Postconditions:</p> <ol style="list-style-type: none"> <li>1. Patient information in run record</li> </ol>	

<b>Use Case: Input Patient Data</b>
ID:
<b>Actors:</b> EMT(s)
<b>Preconditions:</b> <ol style="list-style-type: none"> <li>1. Card reader functional and connected to DEMS</li> <li>2. Run Record Open</li> </ol>
<b>Flow of events:</b> <ol style="list-style-type: none"> <li>1. EMT swipes the patient's driver license through Card Reader</li> <li>2. Card Reader reads driver license</li> <li>3. Card Reader transfers drivers license information to DEMS</li> </ol>
<b>Alternate Flow of Events:</b> <ol style="list-style-type: none"> <li>1. Power goes out</li> <li>2. Manual entry of available data</li> </ol>
<b>Postconditions:</b> <ol style="list-style-type: none"> <li>1. Run Record Fields populated by information read from patient's Drivers License</li> </ol>

<b>Use Case: Transmit Run Record Information (For Mentoring)</b>
ID:
<b>Actors:</b> EMT(s) Transmission System
<b>Preconditions:</b> <ol style="list-style-type: none"> <li>1. Transmission link up and secure</li> <li>2. DEMS operational</li> </ol>
<b>Flow of events:</b> <ol style="list-style-type: none"> <li>1. EMT presses the Send button on the Run Record</li> <li>2. DEMS sends the Run Record to the Physician Workstation H-H</li> </ol>
<b>Postconditions:</b> <ol style="list-style-type: none"> <li>1. Run Record arrives at Physician Workstation H-H</li> </ol>

<b>Use Case: Get Patient Vitals Sign Data</b>
<b>ID:</b>
<b>Actors:</b> EMT(s) Vitals Sign Monitor/12-Lead/other
<b>Preconditions:</b> 1. Patient connected to Propaq or other monitor
<b>Flow of events:</b> 1. EMT presses the Video/Vitals button 2. DEMS displays Patient's ECG rhythm strip (3-lead or 12-lead or other waveform), Pulse Oximetry, Arterial BP, Respiratory Rate, Core Body Temp, Electronic Stethoscope Waveform in real-time
<b>Postconditions:</b> 1. Patient Vitals sign data displayed

<b>Use Case: Access Emergency Protocols</b>
<b>ID:</b>
<b>Actors:</b> EMT(s)
<b>Preconditions:</b> 1. Mentoring
<b>Flow of events:</b> 1. EMT presses Emergency Protocols button 2. DEMS displays list of available protocols 3. EMT selects the protocol to display 4. DEMS displays the selected protocol
<b>Postconditions:</b> 1. Emergency Protocols displayed <b>(Later version will walk EMT through protocols)</b>

<b>Use Case: Managing Mapping Information</b>
<b>ID:</b>
<b>Actors:</b> EMT(s) G.P.S.
<b>Flow of events:</b> <ol style="list-style-type: none"> <li>1. EMT selects mapping information display by pressing Map button</li> <li>2. DEMS displays different choices</li> <li>3. EMT selects destination input function</li> <li>4. DEMS displays the destination input form</li> <li>5. EMT enters the information about destination from list of common destinations</li> <li>6. DEMS displays a map with current position of ambulance as well as the route to follow to get to the destination point and also the ETA</li> </ol>
<b>Postconditions:</b> 1. Mapping information is updated

<b>Use Case: Managing Communication System</b>
<b>ID:</b>
<b>Actors:</b> Communication System ICM (Intelligent Communication System)
<b>Preconditions:</b>
<b>Flow of events:</b> <ol style="list-style-type: none"> <li>1. EMT selects the Comms tab to observe communication monitoring screen</li> <li>2. DEMS displays the bandwidth available between hospital and the ambulance</li> <li>3. EMT selects some medium for enabling or disabling (only available to privilege users)</li> <li>4. DEMS adjusts and displays the updated bandwidth</li> </ol>
<b>Postconditions:</b> 1.

Use Case: Generate Run Record Report	
ID:	
Actors:	EMT(s)
Preconditions:	
Flow of events:	<ol style="list-style-type: none"> <li>1. EMT select "Report" button</li> <li>2. DEMS switch the screen to the run record report display</li> <li>3. EMT, in the top half of the screen, observe and modify the values             <ol style="list-style-type: none"> <li>3.1 Information already should be consistent with "On-Scene" run record values</li> </ol> </li> <li>4. EMT observe the lower half of screen             <ol style="list-style-type: none"> <li>4.1 Historical readings from patient should be present</li> <li>4.2 EMT navigates presented information</li> </ol> </li> <li>5. EMT select "Billing" tab on top of screen</li> <li>6. EMT modify available fields             <ol style="list-style-type: none"> <li>6.1 Information already populated should be consistent with information entered in the "On-Scene" run record</li> <li>6.2 All fields should be modifiable</li> </ol> </li> <li>7. EMT select each of the buttons in the "Billing" display for the type of payment             <ol style="list-style-type: none"> <li>7.1 DEMS record information consistent with EMT(s) selection of the type of payment</li> </ol> </li> <li>8. EMT selects the "Release" tab at the top of the page</li> <li>9. Patient enter initials in the top boxes, and sign and date at the appropriate location</li> <li>10. DEMS accept the patient's input</li> <li>11. EMT sign and date the bottom field             <ol style="list-style-type: none"> <li>11.1 DEMS capture and retain all entered information for future use</li> </ol> </li> <li>12. EMT select the "Transport/Crew" tab at the top of the page</li> <li>13. EMT enters correct information in provided fields             <ol style="list-style-type: none"> <li>13.1 DEMS capture and retain all entered information for future use</li> </ol> </li> <li>14. EMT select the "Report" tab located at the top of the page             <ol style="list-style-type: none"> <li>14.1 DEMS display report page</li> </ol> </li> <li>15. EMT select each element individually to be print previewed             <ol style="list-style-type: none"> <li>15.1 DEMS display a print preview of only the selected element</li> </ol> </li> <li>16. EMT select each element to be printed             <ol style="list-style-type: none"> <li>16.1 DEMS should clearly lay out the report containing only the selected element</li> <li>16.2 DEMS print preview should match what was printed on paper</li> </ol> </li> <li>17. EMT select printout to be done at the hospital             <ol style="list-style-type: none"> <li>17.1 DEMS provides printout at the hospital</li> </ol> </li> <li>18. EMT select printout to be done on the ambulance             <ol style="list-style-type: none"> <li>18.1 DEMS provides printout on the ambulance</li> </ol> </li> </ol>
Postconditions:	

Use Case: Access Training
ID:
Actors:
Preconditions:
<p><b>Flow of events:</b></p> <ol style="list-style-type: none"> <li>1. EMT selects the Training display           <ol style="list-style-type: none"> <li>1.1 DEMS display an index of available training sessions</li> </ol> </li> <li>2. EMT navigate through the available options</li> <li>3. EMT observes what is available           <ol style="list-style-type: none"> <li>3.1 DEMS provides 2D and 3D illustrations, voice, and video</li> <li>3.2 DEMS provides an option for feedback from the EMT</li> <li>3.3 DEMS provides case studies of real emergency calls</li> <li>3.4 DEMS provide an easily accessible on-line medical dictionary</li> <li>3.5 DEMS provides options to be accessible at any time</li> </ol> </li> </ol>
Postconditions:

Use Case: Other ?
ID:
Actors: DEMS System Engineer G.P.S.
Preconditions:
<p><b>Flow of events:</b></p> <ol style="list-style-type: none"> <li>1. DEMS System Engineer upload a new map for the navigation           <ol style="list-style-type: none"> <li>1.1 DEMS should accept the new map and it should work seamlessly with the available system</li> </ol> </li> <li>2. DEMS System Engineer upload new map of a different file format for the navigation system           <ol style="list-style-type: none"> <li>2.1 DEMS uploads the new map and integrate it into the existing system seamlessly</li> </ol> </li> </ol>
Postconditions:

## APPENDIX 4, SECTION 1: DATA DICTIONARY CONCEPTS

Run Record Form concepts-This sheet includes the concept names,datatypes,descriptions of the concepts of the Run Record Form. It includes the concepts of both new and old forms.  
**Code definitions are defined in the code table.**

ConceptID	Abbreviated_Name	Authoritative_Name	Description	Data_Type	Unit	Repeatable	Reference_Names
1	PINum	Patient Number	Identification number of the Patient to which EMS is responding	ST			Liberty County EMS fact Yes sheet
2	Shift	Shift	Shift of the EMS personnel during which the incident occurred	ST			Liberty County EMS fact Yes sheet
3	InciNum	Incident Number	Identification number of the incident to which EMS is responding	ST			Liberty County EMS fact Yes sheet
4	Inci_Date	Incidence date	Date of Incidence	TS			Liberty County EMS fact Yes sheet
5	Inci_WrkRelated	Work related Incident	Boolean code for the incidence being work related or not, noted as yes(Y) or No(n)	BO			Liberty County EMS fact No sheet
6	MilesAt_Hos	Miles at Hospital	Number of miles EMS vehicle travelled when reaching the hospital	NM	miles		Liberty County EMS fact No sheet
7	MilesAt_Sce	Miles At Scene	Meter reading of the EMS vehicle on reaching the scene	NM	miles		Liberty County EMS fact No sheet
8	MilesAt_Tot	Total Miles	Total Number of miles travelled by the EMS vehicle	NM	miles		Liberty County EMS fact No sheet
9	ShopNum	Shop Number	Unit number of the ambulance vehicle unit	ST			Liberty County EMS fact No sheet
10	Amb_Called_By	Ambulance called by whom	Identification of the person/entity calling for the Ambulance (Who called/toned You for an Ambulance:)	CE			Liberty County EMS fact No sheet
11	Tm_Dispatch	Time Dispatch	Time when EMS vehicle (Ambulance) was dispatched in response to the particular call	TS			Liberty County EMS fact No sheet
12	Tm_Enroute	Enroute	Time required enroute while going to the Scene	TS			Liberty County EMS fact No sheet
13	Tm_Arr_Scn	Arrived Scene	Time when EMS vehicle (Ambulance) reached the Scene	TS			Liberty County EMS fact No sheet
14	Tm_Dep_Scn	Departed Scene	Time when EMS vehicle (Ambulance) departed the Scene	TS			Liberty County EMS fact No sheet

15 Tm_Arr_Hos	Arrived Hospital / Landing Zone	Time when EMS vehicle (Ambulance) arrived at the Hospital//Landing Zone	TS	Liberty County EMS fact No sheet
16 Heli_onGrd	Helicopter On Ground	Time at which helicopter lands at LC to pick up	TS	Liberty County EMS fact No sheet
17 Heli_inAir	Heli in Air	Time when Helicopter took off in air with patient	TS	Liberty County EMS fact No sheet
18 Tm_Extrcn	Extrication Time	Time taken for extrication ( time between time on scene and dispatch time)	TS	Liberty County EMS fact No sheet
19 Tm_RTS	Returned To Service	Time when Ambulance returned to service	TS	Liberty County EMS fact No sheet
20 Ori_Add	Origin Address	Address of the place where ambulance was, when call was received	ST	Liberty County EMS fact No sheet
21 Ori_Add_St	Origin Address Street	Street of Origin Address	ST	Liberty County EMS fact No sheet
22 Ori_Add_City	Origin Address City	City of Origin Address	ST	Liberty County EMS fact No sheet
23 Ori_Add_Zip	Origin Address Zip	Zip of Origin Address	ST	Liberty County EMS fact No sheet
24 Dest_Add	Destination Address	Address where the Patient is transported from the Scene	ST	Liberty County EMS fact No sheet
25 Dest_Add_St	Destination Address Street	Street Address of the Destination	ST	Liberty County EMS fact No sheet
26 Dest_Add_City	Destination Address City	City of Destination Address	ST	Liberty County EMS fact No sheet
27 Dest_Add_Zip	Destination Address Zip	Zip of Destination Address	ST	Liberty County EMS fact No sheet
28 PtName_First	First Name/Given Name of the Patient	First name of the Patient as in legal record.	ST	No
29 PtName_Middle	Middle Name or Middle initial of the patient	Middle Name or Middle Initial of the patient	ST	No
30 PtName_Last	Family Name/Last Name of the patient	Last Name/Family Name of the patient	ST	No
31 PtAdd_St	Street Number and Name	Street Number and Name in the Address of the Patient	ST	No
32 PtAdd_City	City	City of stay in patient address:	ST	No

33 PtAdd_State	State	State of Patient's address	ST	No
34 PtAdd_Zip	Zip Code	Zip code in the patient's address	ST	No
35 PtAdd_Country	Country of Residence	Country of residence of the patient	ST	No
36 TeleNum	Telephone Number	Telephone number at which the patient can be contacted	CE	No EMS No. 38; DEEDS 1.09 ASTM E1384 Appendix No X1, 01032
37 DOB	Date/Time of Birth	Patient's date of birth as reported by the patient or on written documentation. Time of birth reported for newborns. It is recommended to record it as YYYY/MM/DD HH:MM:TS	CE	EMS No. 42; DEEDS 1.05; ASTM E1384 Appendix No X1, 01040
38 Sex	Gender/Sex	Sex of the patient at the start of care.	CE	Memorial Hermann No Hospital : Trauma Registry
39 Race	Race	Patient's race coded according to Directive 15 of the Office of Management and Budget and Specification E 1633	CE	CDC Race and Ethnicity No Code Version 1.0
40 Ethnicity	Ethnicity	Patient's ethnicity coded according to CDC race and ethnicity code version 1.0	CE	EMS No. 39; DEEDS 1.11; No AppendixX1, 01020
41 SSN	Social_Security_Num	Patient's ethnicity coded according to CDC race and ethnicity code version 1.0 Administration, if available and released by the patient according to the Federal Privacy Act	ST	Liberty County EMS fact No sheet
42 Pt_Medicare_Num	Patient_Medicare_Number	Medicare Insurance Number of the Patient if available	ST	Liberty County EMS fact No sheet
43 Pt_Medicaid_Num	Patient_Medicaid_Number	Medicaid Insurance Number of the Patient if available	ST	Liberty County EMS fact No sheet
44 Pt_Insu_Nm	Patient_Insurance_Name	Name of Insurance Company with whom patient is insured	ST	Liberty County EMS fact No sheet
45 Pt_Insu_ID_Num	Patient_Insurance_ID_Number	Unique identifying number of patient as issued by the insurance company	ST	Liberty County EMS fact No sheet
46 Pt_Insu_Grp_Num	Patient_Insurance_Group_Number	Group Number to which patient belongs as issued by the insurance company	ST	Liberty County EMS fact No sheet
47 VitalSgn_type	Vital_Signs_type	Signifies record of vital signs of the patient	CE	Liberty County EMS fact No sheet
48 VitalSgn_Value	Vital_Signs_value	Value of the Vital Signs	NM	No
49 VitalSgn_Time	Vital_Signs_Time	Date and Time of recording of vital signs	TS	Liberty County EMS fact Yes sheet

50	GEOC	Glasgow Eye-Opening Component	Patient's eye opening component of the Glasgow Coma Scale.(FOR GCS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet; E 1744 TRUE 6.14.30
51	GMR	Glasgow Motor Response	Patient's motor component of the Glasgow coma scale.(FOR GCS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet; E 1744 TRUE 6.14.32
52	GVR	Glasgow Verbal Response	Patient's verbal response component of the Glasgow coma scale.(FOR GCS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet; E 1744 TRUE 6.14.31
53	RespRteCde	Respiratory Rate Code	Code values for patient's respiratory rate.(FOR RTS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet
54	GCS	Glasgow Coma Scale	Code values for patient's Glasgow coma Scale.(FOR RTS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet
55	SyBPCd	Systolic BP code	Coded value for Systolic Blood Pressure.(FOR RTS CALCULATION PURPOSES)	CE		Liberty County EMS fact sheet
56	PtReqTX_type	Type of Treatments Patient Requires	Documentation of the Treatment and Monitoring required by the patient, as assessed after initial assessment by EMS personnel	CE		Liberty County EMS fact sheet
57	PtReqTX_yes/no	Patient Requires Treatment yes or no	Patient requires treatment yes or no	BO		Liberty County EMS fact sheet Yes
58	PtReqTX_other	Patient Requires other Treatment	Patient requiring treatment not mentioned in the list	ST		Liberty County EMS fact sheet Yes
59	ChiefComp	Chief Complaint_desc	Chief complaint of the patient description.this can be a coded value	ST		Liberty County EMS fact sheet No
60	SndPhyn	Sending Physician	If the patient seen by a physician before sending to hospital through EMS service, identification of the sending physician	ST		Liberty County EMS fact sheet No
61	RecPhyn	Receiving Physician	Physician in the hospital who receives patient from EMS personnel	ST		Liberty County EMS fact sheet No
62	PstMedHX_type	Past medical history_type	Documentation of the past medical history of the patient	CE		Liberty County EMS fact sheet No
63	PstMedHX_yes/no	Past medical history_yes/no	Past medical history yes/no	BO		Liberty County EMS fact sheet No
64	PstMedHX_other	Past medical history_other	Past medical history not included in the coded list	ST		Liberty County EMS fact sheet No
65	Pt_Meds	Patient_Medication	Documentation of patient's current continuing medication	ST		Liberty County EMS fact sheet No
66	Pt_Allergies	Patient's known allergies	Documentation of patient's known allergies	ST		Liberty County EMS fact sheet No
67	Pt_Prior_InPlace_typ	Patient had in place prior to our arrival	Documentation of any devices, monitors or in situ gadgets with the patient when the EMS personnel first see the patient	CE		Liberty County EMS fact sheet No

68_Pt_Prior_InPlace_Yes	Patient prior in place yes/no	Patient had in place prior to the arrival	BO	Liberty County EMS fact
69_skr_condition	Skin condition	Condition of the skin of the patient	CE	No sheet
70_RFD_desc	Reason for delay_desc	Reason for delay to scene	CE	Liberty County EMS fact
71_RFTD_desc	Reason for transport delaydesc	Reason for transport delay	CE	No sheet
72_SMK	smoker	Patient being a smoker or not	BO	Liberty County EMS fact
73_SMK_Yrs	Smoker years	If patient being a smoker, documenting the number of years the patient has been smoking	NM	No sheet
74_SMK_PaD	Smoker Packs per day	If patient being a smoker, documentation of how many packs are smoked per day	NM	Liberty County EMS fact
75_Aut_Ins	Auto Insurance	If the patient is having auto insurance or not	BO	No sheet
76_Aut_Ins_Co	Auto Insurance Company	Name of the Auto Insurance Company	ST	Liberty County EMS fact
77_Auto_Ins_Id#	Auto Insurance Id number	Auto Insurance Idnumber	ST	No sheet
78_Auto_Ins_Claim#	Auto Insurance Claim Number	Auto Insurance claim number	ST	Liberty County EMS fact
79_EXTM_Condn	Extremity_condition	coded element list of condition of the extremities at the scene	CE	No sheet
80_o	EXTM_Condn_Yes_n	Extremity_Condition yes/no	BO	Liberty County EMS fact
81_Pt_Transported	Patient_Transported	coded element list of places where as to where the patient is transported	CE	No sheet
82_ServAgreement_Text	Service Agreement_Text	(LCEMS) and patient has following text: 'I assign LCEMS, Inc. the exclusive irrevocable rights to any cause of action that exists in my favor against any insurance company'	ST	No Liberty County Fact sheet
83_ServAgreement_SignPt	Agreement_Signature of Patient	Signature of the patient as to the agreement of the Service Agreement	ST	No Liberty County Fact sheet

84	ServAgreement_DtTm	Agreement_Date & Time	Date and time record of the Service Agreement between LCEMS and patient	TS		No Liberty County Fact sheet
85	ServAgreement_Witns	Service Agreement_Witness	Signature of the witness of the Service Agreement between LCEMS and patient	ST		No Liberty County Fact sheet
86	Medic_Sign	MEDIC Signature	Signature of the MEDIC submitting the EMS fact sheet	ST		No Liberty County Fact sheet
87	Medic_EmployNum	MEDIC Employee Number	Employee Identification number of the MEDIC submitting the EMS fact sheet	NM		No Liberty County Fact sheet
88	Medic_Skill	MEDIC Skill	Skill level of the MEDIC attending (codes not available..??)	CE		No Liberty County Fact sheet
89	DRVSign	DRIVER Signature	Signature of the DRIVER of the EMS vehicle	ST		No Liberty County Fact sheet
90	DRV_EmployNum	Driver Employee Number	Employee Identification number of the Driver submitting the EMS fact sheet	ST		No Liberty County Fact sheet
91	DRV_Skill	Driver Skill	Skill level of the Driver attending (codes not available..??)	CE		No Liberty County Fact sheet
92	RecvPersSgn	Receiving Person's Signature	Signature of the person receiving the EMS fact sheet	ST		No Liberty County Fact sheet
93	RecvPersSgn_Dt	Receiving Person's Signature_Date	Documentation of the date of the Receiving Person's Signature	TS		No Liberty County Fact sheet
94	ReleOfInfoAutho_sign	Patient	Patient's signature consenting to release of information	ST		No Liberty County Fact sheet
95	ReleOfInfoAutho_why	Information	Released of Information	ST		No Liberty County Fact sheet
96	ReleOfInfoAutho_Rel	Relationship	Reason as to why the patient can not sign on the release info	ST		No Liberty County Fact sheet
97	Refusl_MedTrt	Medical Treatment	If any of the relatives signs the agreement for 'Released of Information Authorization', documentation of the relationship of the person signing on behalf of the patient and signature of the relative	ST		No Liberty County Fact sheet
98	Refusl_Tmsport	Transport	If the patient refuses to take medical treatment, documentation of doing so	BO		No Liberty County Fact sheet
99	Refusl_Sign	Signature	If the patient refuses to take transport service, documentation of do so	BO		No Liberty County Fact sheet
			If the patient refuses to take Medical Treatment or Transport at this time, then signature of the patient as a evidence of doing so	ST		No Liberty County Fact sheet

ConceptID	Abbreviated_Name	Authoritative_Name	Description	Data_Type	Unit	Repeatable	Reference_Names
100	Med_Gvn_Tm	Medication given time	Time of administration of a particular medication	TS			Liberty County EMS ALS No Report Form
101	Med_Gvn_Drg	Medication given drugs	documentation of name of the drug given at a particular time((codes not available...?))	ST			Liberty County EMS ALS No Report Form
102	Med_Gvn_Amt	Medication given amount	Amount of a particular drug given at a particular time	NM			Liberty County EMS ALS No Report Form
103	Med_Gvn_Rte	Medication given route	Route through which medication is given	ST			Liberty County EMS ALS No Report Form
104	Med_Gvn_APS	Medication given Attending person signature	Attending person signature	ST			Liberty County EMS ALS No Report Form
105	Defib/Pcing_Tm	Defibrillation/Pacing time	Time of the defibrillation/pacing	TS			Liberty County EMS ALS No Report Form
106	Defib/Pcing_Rtm	Defibrillation/Pacing rhythm	Rhythm of defibrillation/pacing	NM			Liberty County EMS ALS No Report Form
107	Defib/Pcing_Wst	Defibrillation/Pacing wait/set	number of wait/set of defibrillation/pacing	NM	wait		Liberty County EMS ALS No Report Form
108	Defib/Pcing_Rsts	Defibrillation/Pacing Results	Results of defibrillation	ST			Liberty County EMS ALS No Report Form
109	Defib/Pcing_A.P.S.	Attending.Person.Signature.	Attending person signature	ST			Liberty County EMS ALS No Report Form
110	AW_Ty	Airway type	Type of the Airway	CE			Liberty County EMS ALS No Report Form
111	AW_Tm	Airway Time	Time at which Airway was put in	TS			Liberty County EMS ALS No Report Form
112	AW_Sz	Airway Size	Size of the airway put in	NM			Liberty County EMS ALS No Report Form
113	AW_Atm	Airway Attempts	Number of attempts made to put in a particular airway	NM			Liberty County EMS ALS No Report Form
114	AW_A.P.S.	Attending.Person.Signature.	Attending person signature	ST			Liberty County EMS ALS No Report Form
115	ECG_Tm	Times of ECG	Time of ECG done	TS			Liberty County EMS ALS Yes Report Form
116	ECG_Rhym	ECG Rhythm	Documentation of the rhythm of the ECG done	ST			Liberty County EMS ALS No Report Form
117	Nrtv	Narrative	Narrative documentation any other important information in the ALS Report Form	ST			Liberty County EMS ALS No Report Form

Concept ID	Abbreviated_Name	Authoritative_Name	Description	Data_Type	Unit	Repeatable	Reference_Names
118	Illnes_Symtm	Illness_Symptom_Hea rt	Documentation of present and suspected illness of heart in the patient	CE			Liberty County EMS No Trauma Report Form
119	Illnes_Symtm_Pain	Illness_Symptom_Pai n	Documentation of pain sites	CE			Liberty County EMS No Trauma Report Form
120	Illnes_Symtm_Cerebr ovas	Illness_Symptom_Cer ebrovascular	Documentation of any Cerebrovascular disease	CE			Liberty County EMS No Trauma Report Form
121	Illnes_Symtm_InfectD	Illness_Symptom_Infe ctious Disease	Documentation of any Infectious Disease	CE			Liberty County EMS No Trauma Report Form
122	Illnes_Symtm_Seizu	Illness_Symptom_Sei zure	Documentation of type of Seizure	CE			Liberty County EMS No Trauma Report Form
123	Illnes_Symtm_Lung	Illness_Symptom_Lun g	Documentation of any Lung Disease	CE			Liberty County EMS No Trauma Report Form
124	Illnes_Symtm_Diabeti c	Illness_Symptom_Dia betic	Patient is known to have Diabetic complications	CE			Liberty County EMS No Trauma Report Form
125	Illnes_Symtm_Injry_T	Illness_Symptom_Inju ry_Type	Documentation of Injury type	CE			Liberty County EMS No Trauma Report Form
126	Illnes_Symtm_Injry_P	Illness_Symptom_Inju ry_Place_of_occurance	This category gives the place of occurrence of injury	CE			Liberty County EMS No Trauma Report Form
127	Illnes_Symtm_Cncer	Illness_Symptom_Can cer	Patient is known to have cancer,type of cancer	CE			Liberty County EMS No Trauma Report Form
128	Illnes_Symtm_Gastrin	Illness_Symptom_Gas trintestinal	Patient is known to have gastrointestinal symptoms	CE			Liberty County EMS No Trauma Report Form
129	Illnes_Symtm_Resp	Illness_Symptom_Respiratory	Documentation of Respiratory symptoms	CE			Liberty County EMS No Trauma Report Form
130	Illnes_Symtm_AltMent	Illness_Symptom_Altern ed Mental Status	Documentation of AMS in the patient	CE			Liberty County EMS No Trauma Report Form
131	Illnes_Symtm_Other	Illness_Symptom_Other	Mention other present or suspected illness/symptom known or observed in the patient which are not listed above	ST			Liberty County EMS No Trauma Report Form

132	TraumInfo_ProbCaus e_Transprt	Trauma Information_Probable Cause_Transprt	The probable cause of trauma is related to transport	CE			Liberty County EMS No Trauma Report Form
133	TraumInfo_ProbCaus e_Transprt_Code_Subcode	Trauma Information_Probable Cause_Transprt_Code_Subcode	These are the decimal digit codes to be used with codes related to concept Trauma Information_Probable Cause_Transprt (00482)	CE			Liberty County EMS No Trauma Report Form
134	TraumInfo_ProbCaus e_OtherCauses	Trauma Information_Probable Cause_Other causes	The probable cause of trauma is other than the transport	CE			Liberty County EMS No Trauma Report Form
135	TraumInfo_ProbCaus e_Other_Code_Subcode	Trauma Information_Probable Cause_Other Other_Codes_Code_Subcode	These are the decimal digit codes to be used with codes related to concept Trauma Information_Probable Cause_Other causes (00488)	CE			Liberty County EMS No Trauma Report Form
136	Traumainfo_Preventive Aid	Trauma Information_Preventiv e Aid	Preventive aid which was being used at the time of trauma	CE			Liberty County EMS No Trauma Report Form
137	Traumainfo_AidPrior Arriv	Trauma Information_Aid Prior to Arrival	Aid which was being available prior to arrival	CE			Liberty County EMS No Trauma Report Form
138	Traumainfo_Injury_Inj uryType	Trauma Information_Injury_Inj ury Type	Coded element indicating the type of injury of the patient	CE			Liberty County Trauma No Report Form
139	Traumainfo_Injury_Inj urySeverity	Trauma Information_Injury_Inj ury Severity	Coded element indicating the severity of injury of the patient	CE			Liberty County Trauma No Report Form
140	Traumainfo_Injury_Inj uryLocation	Trauma Information_Injury_Inj ury Location	Coded element indicating the location of the injury of the patient	CE			Liberty County Trauma No Report Form
141	Refusl_MedTrt	Refusal_Medical Treatment	Refusal of Transport Concepts - This sheet includes the concept names, datatypes, and descriptions of the concepts of the Refusal of Transport form.	BO			No Liberty County Fact sheet



153 XtraAttn_CPR	Extra Attendant CPR	Number of extra attendants for performing CPR	NM	Liberty County EMS No Charge sheet
154 XtraAttn_3MnLt	Extra Attendant 3 MAN_LIFT	Number of extra attendant for a 3 MAN-LIFT	NM	Liberty County EMS No Charge sheet
155 XtraAttn_Bging	Extra Attendant Bagging	Number of extra attendants for bagging	NM	Liberty County EMS No Charge sheet
156 RoutnSup_type	Routine_Supplies_type	category of routine chargeable supplies used by the patient	CE	Liberty County EMS No Charge sheet
157 RoutnSup_Qty	Routine_Supplies_Qty	Number of the supplies used	NM	Liberty County EMS No Charge sheet
163 AwMnt_servc_supp1_type	Airway Maintenance_supplies_type	This category mentions the services supplies related to airway maintenance	CE	Liberty County EMS No Charge sheet
164 AwMnt_Qty	Airway Maintenance_quantity	It defines the number/measure of the supply related to airway maintenance	NM	Liberty County EMS No Charge sheet
165 OtrSpecServ_desc	Other Specialized Services_description	This category gives the list of other specialized services	CE	Liberty County EMS No Charge sheet
166 OtrSpecServ_Qty	Other Specialized Services_Quantity	Number of other special service (selected in the coded list) used for the patient	NM	Liberty County EMS No Charge sheet
167 CardMinitor_supp	Cardiac Monitor	This category gives details of the services/supplies related to Cardiac Monitor, for patient charge sheet	CE	Liberty County EMS No Charge sheet
168 Qty	CardMinitor_supplies_Quantity	Monitor_supplies_Quantity	NM	Liberty County EMS No Charge sheet
169 IV_Ther_supp	Therapy_supplies	It defines the number/measure of the supply related to cardiac monitor	CE	Liberty County EMS No Charge sheet
170 IV_Ther_supp_Qty	IV_Therapy_supplies_Quantity	This category gives the services/supplies related to IV Therapy	NM	Liberty County EMS No Charge sheet
171 Immobil_Type	Immobilization_Type	It defines the number/measure of the supply related toIV therapy	CE	Liberty County EMS No Charge sheet
172 Immobil_Supp_Qty	Immobilization_supplies_Quantity	This category gives the details of services/supplies under the category of Immobilization for patient's charge sheet	CE	Liberty County EMS No Charge sheet
Bleeding_Contr_Dresi ng_type	Bleeding_Control_Dressing_supplies	Number/measure of immobilization supplies used for the patient.	NM	Liberty County EMS No Charge sheet
173 ng_type	Bleeding_Control_Dressing_supplies	This category describes the services/supplies for emergency treatment related to Bleeding control or Dressing	CE	Liberty County EMS No Charge sheet
174 Bleeding_ContrH_Qty	Bleeding_Control_Dressing_Quantity	number of such Bleeding_Control_Dressing supplies used for the patient	NM	Liberty County EMS No Charge sheet
175 Infectious_contrl_sup	Control_supplies	This category mentions services/supplies for infectious control	CE	Liberty County EMS No Charge sheet

176	Infectious_ctrl_Qty	Infectious_Control_Bic_hazard_Bag_Quantity	Number/measure of infectious control supplies used for the patient	NM					Liberty County EMS No Charge sheet
177	Misc_supplies	Miscellaneous_supplies	This category mentions services and supplies related to miscellaneous section	CE					Liberty County EMS No Charge sheet
178	Misc_supp_Qty	Miscellaneous_qty	Number/measure of miscellaneous supplies used for the patient	NM					Liberty County EMS No Charge sheet
179	Pharm_Adult	Pharmaceuticals_Adult	This category mentions the pharmaceuticals for adults	CE					Liberty County EMS No Charge sheet
180	Pharm_Adult_Qty	Pharmaceuticals_Adult_Quantity	Quantity of medication_Adult) used	NM					Liberty County EMS No Charge sheet
181	Pharm_Pedi	Pharmaceuticals_Pedi	This category gives pharmaceuticals for pediatrics	CE					Liberty County EMS No Charge sheet
182	Pharm_Pediatric_City	Pharmaceuticals_Pediatric_Quantity	Quantity of medication(Pediatric) used	NM					Liberty County EMS No Charge sheet
183	Blood_Tube_glucose	Blood_Tube_glucose	This category mentions the supplies necessary for blood glucose testing	CE					Liberty County EMS No Charge sheet
184	Blood_Tube_glucose_Qty	Blood_Tube_glucose_Quantity	Quantity of supplies used for blood glucose testing	NM					Liberty County EMS No Charge sheet
ConceptID	Abbreviated_Name	Authoritative_Name	Description	Data_Type	Unit	Repeatable	Reference_Names		
185	Bl_Chem_S_Na	Blood_Chemistry_Serum_Sodium	Serum sodium value	NM	L, mEq/	Yes	Harrison's Principles of Internal Medicine		
186	Bl_Chem_S_K	Blood_Chemistry_Serum_Potassium	Observed Serum potassium value	NM	L, mEq/	Yes			
187	Bl_Chem_S_Cl	Blood_Chemistry_Serum_Chloride	Serum chloride value	NM	L, mEq/	Yes			
188	Bl_Chem_i_Ca	Blood_Chemistry_Serum_Calcium	Ionized calcium value in blood	NM	L / mg/d	Yes			
189	Bl_Chem_pH	Blood_Chemistry_pH	pH of blood	NM		Yes			
190	Bl_Chem_pCO2	Blood_Chemistry_pCO2	carbon dioxide tension (pCO2) in blood	NM	mm of Hg, kPa	Yes			
191	Bl_Chem_pO2	Blood_Chemistry_pO2	Oxygen tension (pO2) in blood	NM	mm of Hg, kPa	Yes			

192	BL_Chem_Glu	Blood_Chemistry_Glucose	Blood Glucose value (measured as plasma glucose)	NM	L, mg/d	Yes	
193	BL_Chem_Creatinine	Blood_Chemistry_Creatinine	Serum Creatinine value	NM	L, umol/L	Yes	
194	BL_Chem_Lactate	Blood_Chemistry_Lactate	Blood lactate value (as measured in venous plasma)	NM	L, mmol/L	Yes	
195	BL_Chem_BUN	Blood_Chemistry_Blood Urea Nitrogen	Blood Urea Nitrogen (BUN) value (as measured in serum)	NM	L, mmol/L	Yes	
196	BL_Chem_Urea	Blood_Chemistry_Urea				No	
197	Proto_Basic_Intervention	Protocol_Basic_Intervention	In a protocol, basic interventions involve, primary and secondary survey of the patient, obtaining quick history and giving basic life support as deemed necessary upon survey	ST		Support for Doctors (Instructor Course Manual, No 97)	
198	Pri_Survey	Protocol_Basic_Intervention_Primary_Survey	The Primary Survey is a rapid assessment performed on every patient to evaluate the presence or absence of life-sustaining bodily functions. The rapid assessment is performed in the following order: Airway, Breathing, Circulation, and Delicate CNS.	ST		Advanced Trauma Life Support for Doctors (Instructor Course Manual, No 97)	
199	Sec_Survey	Protocol_Basic_Intervention_Secondary_Survey	The secondary survey is a systematic head to toe examination (infants and children should be examined from toe to head) that is pertinent to the patient's chief complaint, physical findings and significant history. It is performed after the primary survey	ST		Support for Doctors (Instructor Course Manual, No 97)	
200	pprt	Protocol_Advanced_Life_Support_Supprt_Immediate	In a protocol, the advanced life support mentions treatment measures for a specific medical condition, segregating the intermediate and paramedic interventions. This starts after basic intervention is completed.	ST		Support for Doctors (Instructor Course Manual, No 97)	
201	pprt_Intrm_Intrvn	Protocol_Advanced_Life_Support_Intermediat_e Intervention	Category mentioning interventions to be performed by the EMT intermediate at scene as part of advanced life support	ST		Advanced Trauma Life Support for Doctors (Instructor Course Manual, No 97)	
202	pprt_Paramed_Intrvn	Protocol_Advanced_Life_Supprt_Paramedic Intervention	Category mentioning interventions to be performed by the paramedic at scene, as part of advanced life support	ST		Advanced Trauma Life Support for Doctors (Instructor Course Manual, No 97)	
203	Proto_Med_Control	Protocol_Medical_Control	Medical Control as mentioned in protocols, refers to the physician reference station for the EMS, in this case Physician station in Hermann hospital	ST		Advanced Trauma Life Support for Doctors (Instructor Course Manual, No 97)	
204	Dispositn_Destin_Det_Determinor	Disposition_Destin_Det_Disposition_Determinor	Coded values identifying the person determining the reason for the transport destination	CE		FALSE E1744 6.14.57 (codess..??)	
205	Dispositn_Destin_Det_Determinin	Disposition_Destin_Det_Disposition_Determination	Reason a transport destination was selected	CE		FALSE E 1744 6.14.58	

206	Disposition_Disposition_Tra nsferTo	Disposition_Dispositio n/Transferred to	Health care facility or pre-hospital unit/home that received patient from EMS responder providing this record. Facilities should be recorded by identification numbers which are unique statewide.	CE		FALSE	E 1744 6.14.59
207	Disposition_Incident/Pt_ disposition	Disposition_Incident/Pt_ atient Dispositio n	End result of EMS response. This will provide information about the reasons for which EMS is notified, correlated with the ultimate incident disposition	CE		FALSE	E 1744 6.14.59
208	Disposition_Incident/Pt_ ConditionAtDestinatn	Disposition_Condition on arrival at destination	Coded values to indicate the patient's condition on arrival at the hospital	CE		FALSE	E 1744 6.14.59

**APPENDIX 4, Section 2: DATA DICTIONARY CODE ELEMENT LIST**

**Run Record Form code element List** – This part of the sheet includes the Code elements of the concepts present in Run Record Form.

			Code	Code_Authoritative_Name	Code_Description	Unit	Code_Reference_Name	Code_Ref_Code	Concept_ID
HM		TelNum_Contact_Home_Phone			The phone numbers of both permanent and temporary addresses		ASTM E 1633 PARA 4.2.3		36
BU		TelNum_Contact_Business_Phone			Current work phone number of patient or guarantor, if applicable.		ASTM E 1633 PARA 4.2.3		36
TM		TelNum_Contact_Temporary_Phone			The telephone at the temporary address		ASTM E 1633 PARA 4.2.3		36
FX		TelNum_Contact_Fax_Number			Given fax number of the patient		ASTM E 1633; ISO 5218		36
BP		TelNum_Contact_Beeper			Beeper(pager) number of the patient		ASTM E 1633; ISO 5218		36
CE		TelNum_Contact_Cellular_Phone			Cellular phone number of the patient		ASTM E 1633; ISO 5218		36
AS		TelNum_Contact_Answering_Service			Answering Service contact		ASTM E 1633; ISO 5218		36
M		Sex_Male			Male		ASTM E 1633; ISO 5218		38
F		Sex_Female			Female		ASTM E 1633; ISO 5218		38
U		Sex_Unknown			Unknown		ASTM E 1633; ISO 5218		38
MP		Sex_Male_Pseudohermaphrodite			Male Pseudohermaphrodite		ASTM E 1633; ISO 5218		38
FP		Sex_Female_Pseudohermaphrodite			Female Pseudohermaphrodite		ASTM E 1633; ISO 5218		38
Hp		Sex_Hermaphrodite			Hermaphrodite		ASTM E 1633; ISO 5218		38
MC		Sex_Male_to_Female			Male changed to Female		ASTM E 1633; ISO 5218		38
FC		Sex_Female_to_Male			Female changed to male		ASTM E 1633; ISO 5218		38
A		Race_Asian			Patient belongs to Asian Race		Hermann Hospital Trauma Registry		39
BL		Race_Black			Patient belongs to Black Race		Hermann Hospital Trauma Registry		39
BH		Race_Black_Hispanic			Patient belongs to Black-Hispanic Race		Hermann Hospital Trauma Registry		39
Hi		Race_Hispanic			Patient belongs to Hispanic race		Hermann Hospital Trauma Registry		39
I		Race_Native_American			Patient belongs to native american race (includes Alaskan Native)		Hermann Hospital Trauma Registry		39
PI		Race_Pacific_Islander			Patient belongs to Pacific-Islander race		Hermann Hospital Trauma Registry		39

W	Race_White_NonHispanic	Patient belongs to White-Non-Hispanic race	Hermann Hospital Trauma Registry	39
ME	Race_Middle_Eastern	Patient belongs to Middle-Eastern race	Hermann Hospital Trauma Registry	39
IS	Race_Indian	Patient belongs to Indian race	Hermann Hospital Trauma Registry	39
O	Race_Other	Patient belongs to a race which is other than coded	Hermann Hospital Trauma Registry	39
UNK	Race_Unknown	Patient's race being not known	Hermann Hospital Trauma Registry	39
NA	Race_NotApplicable	Race documentation is not applicable to the current patient record	Hermann Hospital Trauma Registry	39
NOT	Race_NotDone	Race code documentation not done	Hermann Hospital Trauma Registry	39
E1	Ethnicity_Hispanic	Hispanic or Latino (syn. Spanish)	CDC Race and Ethnicity Codes Version 1.0	40
E2	Ethnicity_NonHisp	Not Hispanic or Latino by ethnic origin	CDC Race and Ethnicity Codes Version 1.0	40
01_MS	Amb_called_by_Med_Staff	Indicating that the a Medical Staff called/toned for an Ambulance	2135-2	40
02_SE	Amb_called_by_Self	indicating that the person calling for Ambulance was patient itself	2186-5	40
03_FM	Amb_called_by_Family	indicating that the person calling for Ambulance was one of the family members of the patient		10
04_PO	Amb_called_by_Police/LSO	indicating that the person who called/toned for the Ambulance belonged to Police or LSO		10
05_DR	Amb_called_by_Doctor	indicating that the person who called/toned for the Ambulance was a Physician		10
06_EMS	Amb_called_by_EMS	indicating that the person who called/toned for Ambulance belonged to EMS		10
01_SBP	Vital Signs_Blood Pressure	Signifys record of Blood Pressure of the Patient recorded as BP/ Diastolic BP, as part of vital signs measured in mm of Hg normal range- (130/85),critical being 210 mm of Hg mmHg		47

02_PUL	Vital Signs_Pulse	Signify's Patient's palpated or auscultated pulse rate expressed in number per minute normal high-100,normal low-50,critical high-200,critical low -50	number per minute	47
03_RE_01	Resp_effort_Normal	Normal respiratory effort	E 1744.6.14.26	47
03_RE_02	Vital Signs_Resp_effort_Increased_not laboured	This code signifies Increased respiratory effort seen, though respiration doesn't appear laboured	E 1744.6.14.26	47
03_RE_03	Vital Signs_Resp_effort_Increased_and_laboured_or_decreased_and_fatigued	This code signifies increased and laboured respiratory effort or decreased and fatigued respiratory effort	E 1744.6.14.26	47
03_RE_04	Vital Signs_Resp_effort_Absent	This code signifies absent respiratory effort	E 1744.6.14.26	47
03_RE_05	Vital Signs_Resp_effort_Not_assessed	This code is used when respiratory effort of the patient is not assessed	E 1744.6.14.26	47
04_OSAT	Vital Signs_Oxygen Saturation	Arterial oxygen saturation measured in percentage,Normal high - 100,normal low-90	percent age	47
05_RTS	Vital Signs_RTS	Revised trauma score ,Normal -12,critical -11	Liberty County EMS fact sheet	47
06_GCS	Vital Signs_GCS	Glasgow coma scale score	Liberty County EMS fact sheet	47
07_BGL	Vital Signs_BGL	Blood Glucose level,Normal high,Normal low - .Critical high-critical low-	mg/dl	47
00_RTS_RR	RTS_RR_00	Respiratory rate (SCALE USED TO CALCULATE RTS) is zero per minute	Liberty County EMS fact sheet	53
01_RTS_RR	RTS_RR_1_5	Respiratory Rate(SCALE USED TO CALCULATE RTS) between 0 to 5 per minute	Liberty County EMS fact sheet	53
02_RTS_RR	RTS_RR_6_9	Respiratory Rate(SCALE USED TO CALCULATE RTS) between 6 and 9 per minute	Liberty County EMS fact sheet	53
03_RTS_RR	RTS_RR_10_29	Respiratory Rate(SCALE USED TO CALCULATE RTS)between 10 and 29 per minute	Liberty County EMS fact sheet	53

04_RTS_RR	RTS_RR_>29	Respiratory Rate(SCALE USED TO CALCULATE RTS) more than 29 per minute	Liberty County EMS fact sheet	53
00_RTS_GCS	RTS_GCS_0_3	Glasgow coma scale(SCALE USED TO CALCULATE RTS) score = 0 to 3	Liberty County EMS fact sheet	54
01_RTS_GCS	RTS_GCS_4_5	Glasgow coma scale(SCALE USED TO CALCULATE RTS) score = 4 to 5	Liberty County EMS fact sheet	54
02_RTS_GCS	RTS_GCS_6_8	Glasgow coma scale (SCALE USED TO CALCULATE RTS)score: 6 to 8	Liberty County EMS fact sheet	54
03_RTS_GCS	RTS_GCS_9_12	Glasgow coma scale(SCALE USED TO CALCULATE RTS) score: 9 to 12	Liberty County EMS fact sheet	54
04_RTS_GCS	RTS_GCS_13_15	Glasgow coma scale score(SCALE USED TO CALCULATE RTS): 13 to 15	Liberty County EMS fact sheet	54
00_RTS_SBP	RTS_SyBPCd_0	Code Signifying Systolic Blood Pressure of the Patient as Zero (0) mm Hg	mmHg	Liberty County EMS fact sheet
01_RTS_SBP	RTS_SyBPCd_1_49	Code Signifying Systolic Blood Pressure(SCALE USED TO CALCULATE RTS) of the Patient as between 1 and 49 mm Hg	mmHg	Liberty County EMS fact sheet
02_RTS_SBP	RTS_SyBPCd_50_75	Code Signifying Systolic Blood Pressure of the Patient as between 50 to 75 mm Hg	mmHg	Liberty County EMS fact sheet
03_RTS_SBP	RTS_SyBPCd_76_89	Code Signifying Systolic Blood Pressure(SCALE USED TO CALCULATE RTS) of the Patient as between 76 to 89 mm Hg	mmHg	Liberty County EMS fact sheet
04_RTS_SBP	RTS_SyBPCd_>89	Code Signifying Systolic Blood Pressure(SCALE USED TO CALCULATE RTS) of the Patient as more than 89 mm Hg	mmHg	Liberty County EMS fact sheet
01_GCS_GEOC	GEOC_No_Response	Glasgow Eye Opening Component(SCALE USED TO CALCULATE GCS) : 'no' eye opening response by the patient	Liberty County EMS fact Sheet; E 1744 6.14.30	50
02_GCS_GEOC	GEOC_To_Pain	Glasgow Eye Opening Component (SCALE USED TO CALCULATE GCS): Patient opens eyes in response to painful stimulation	Liberty County EMS fact Sheet; E 1744 6.14.30	50

03_GCS_GEOC	GEOC_To_Verbal	Glasgow Eye Opening Component(SCALE USED TO CALCULATE GCS) : Patient opens eyes in response to verbal stimulation	Liberty County EMS fact Sheet; E 1744 6.14.30	50
04_GCS_GEOC	GEOC_Spontaneous	Glasgow Eye Opening Component(SCALE USED TO CALCULATE GCS); Opens eyes spontaneously	Liberty County EMS fact Sheet; E 1744 6.14.30	50
01_GCS_GMR	GMR_None	Glasgow Motor Response(SCALE USED TO CALCULATE GCS) : No Response	Liberty County EMS fact sheet; E 1744 6.14.32	51
02_GCS_GMR	GMR_Extension	Glasgow Motor Response(SCALE USED TO CALCULATE GCS); Extensor posturing in response to painful stimulation	Liberty County EMS fact sheet; E 1744 6.14.32	51
03_GCS_GMR	GMR_Flexion_Abnormal	Glasgow Motor Response(SCALE USED TO CALCULATE GCS); Flexor posturing in response to painful stimulation	Liberty County EMS fact sheet; E 1744 6.14.32	51
04_GCS_GMR	GMR_Flexion_Withdrawal	Glasgow Motor Response(SCALE USED TO CALCULATE GCS); General withdrawal in response to painful stimulation	Liberty County EMS fact sheet; E 1744 6.14.32	51
05_GCS_GMR	GMR_Localizes_Pain	Glasgow Motor Response(SCALE USED TO CALCULATE GCS) ; Localization of painful stimulation	Liberty County EMS fact sheet; E 1744 6.14.32	51
06_GCS_GMR	GMR_Obeys_commands	Glasgow Motor Response(SCALE USED TO CALCULATE GCS); Obey's commands with appropriate motor response	Liberty County EMS fact sheet; E 1744 6.14.32	51
01_GCS_GVR	GVR_None	Glasgow Verbal Response(SCALE USED TO CALCULATE GCS); No Response	Liberty County EMS fact sheet; E 1744 6.14.31	52
02_GCS_GVR	GVR_Incomplete_Sound	Glasgow Verbal Response(SCALE USED TO CALCULATE GCS); Incomplete Non-specific sounds	Liberty County EMS fact sheet; E 1744 6.14.31	52
03_GCS_GVR	GVR_Inappropriate_Words	Glasgow Verbal Response(SCALE USED TO CALCULATE GCS) : Inappropriate words	Liberty County EMS fact sheet; E 1744 6.14.31	52
04_GCS_GVR	GVR_Disoriented/converse	Glasgow Verbal Response(SCALE USED TO CALCULATE GCS); Confused conversation or speech	Liberty County EMS fact sheet; E 1744 6.14.31	52

05_GCS_GVR	GVR_Orient/converse	Glasgow Verbal Response(SCALE USED TO CALCULATE GCS): Oriented and appropriate speech	Liberty County EMS fact sheet; E 1744 6.14.31
01_PReqTX_CardMont	Patient requires Cardiac Monitor	Patient requires Cardiac Monitor as part of treatment	
02_PReqTX_Pacing	Patient requires Pacing	Patient requires Cardiac Pacing as part of treatment	
03_PReqTX_VS	Patient requires Vital Signs monitoring	Patient requires Vital Signs monitoring as part of treatment	
04_PReqTX_CPR	Patient requires CPR	Patient requires CPR as part of Treatment	
05_PReqTX_IV	Patient requires IV treatment	Patient requires Intravenous Fluid Treatment as part of Treatment	
06_PReqTX_Glu	Patient requires Glucose	Patient requires Glucose as part of Treatment	
07_PReqTX_PO	Patient requires PulseOximeter	Patient requires pulseoximeter monitor to monitor pulse and peripheral oxygen saturation as part of treatment	
08_PReqTX_o2	Patient requires Oxygen	Patient requires oxygen as part of treatment	
09_PReqTX_Labs	Patient requires Labs	Patient requires Labs investigation as part of treatment	
10_PReqTX_Meds	Patient requires medications	Patient requires medications as part of treatment	
11_PReqTX_Intu	Patient requires intubation	Patient requires intubation as part of treatment	
12_PReqTX_Defib	Patient requires defibrillation	Patient requires defibrillation as part of treatment	
13_PReqTX_Immobilb/spt	Patient requires Immobilization/splinting	Patient requires immobilization or splinting as part of treatment	
14_PReqTX_Suc	Patient requires suction	Patient requires suction as part of treatment	
15_PReqTX_AWMMaint	Patient requires airway maintenance	Patient requires airway maintenance as part of treatment	
16_PReqTX_BldCtl	Patient requires bleeding control	Patient requires bleeding control as part of treatment	
01_PstMedHX_Car	Past medical history_cardiac	Past medical history of cardiac diseases	
02_PstMedHX_HTN	Past medical history_hypertension	Past medical history of hypertension	

03_PstMedHX_DgAbu	Past medical history_drug abuse	Past medical history of drug abuse	62
04_PstMedHX_Contr	Past medical history_contracture	Past medical history of contracture	62
05_PstMedHX_LvrFl	Past medical history_liver failure	Past medical history of liver failure	62
06_PstMedHX_Sez	Past medical history_seizure	Past medical history of seizures	62
07_PstMedHX_Alz	Past medical history_alzheimer	Past medical history of alzheimer's disease	62
08_PstMedHX_Dbts	Past medical history_Diabetes	Past medical history of diabetes	62
09_PstMedHX_COPD	Past medical history_COPD	Past medical history of COPD ( Chronic Obstructive Pulmonary Disease)	62
10_PstMedHX_CVA_Pth	Past medical history_CVA	Past medical history of Cerebro Vascular Accident or Paralysis	62
11_PstMedHX_Hystmy	Past medical history_hysterectomy	Past medical history of hysterectomy	62
12_PstMedHX_Cnr	Past medical history_cancer	Past medical history of cancer	62
13_PstMedHX_Arths	Past medical history_Arthritis	Past medical history of arthritis	62
14_PstMedHX_Astlm	Past medical history_asthma	Past medical history of asthma	62
15_PstMedHX_ESRD	Past medical history_ESRD	Past medical history of end stage renal disease	62
16_PstMedHX_DegJt	Past medical history_degenerative joint	Past medical history of degenerative diseases	62
17_PstMedHX_Ganm	Past medical history_gangrene	Past medical history of gangrene	62
18_PstMedHX_GB	Past medical history_gall bladder	Past medical history of gall bladder disease	62
19_PstMedHX_DecubUli	Past medical history_decubitus ulcer	Past medical history of decubitus ulcer	62
20_PstMedHX_Aptomy	Past medical history_appendectomy	Past medical history of appendectomy	62
21_PstMedHX_Otr	Past medical history_other	Past medical history of any other disease or disorder other than mentioned	62
01_CL	Patient prior in place central line	Patient having prior central line in place	67
02_FC	Patient prior in place foley's cathether	Patient having prior Foley's catheter in place	67
03_IV_Med	Patient prior in place IV or Med	Patient having I.V. line or being given I.V. Medicines when EMS personnel arrive at the scene	67
04_Oxy	Patient prior in place oxygen	Patient being administered oxygen when EMS personnel arrive at the scene	67
05_Pg_GT	Patient prior in place Peg/G-Tube	Patient with prior Percutaneous enteral Gastrostomy (PEG) or G Tube (Gastric tube) in place when EMS personnel arrive at the scene	67
06_Rstr	Patient prior in place restraints	Patient with prior restraints when EMS personnel reached scene	67
07_Snt	Patient prior in place shunt	Patient with prior placed shunt, when EMS personnel reached scene	67

08_TraTu	Patient prior in place tracheal tube	Patient with prior tracheal tube in place, when EMS personnel reached scene	67
09_Diap	Patient prior in place diaper	Patient with prior placed diapers in place, when EMS personnel reached scene	67
10_Cst	Patient prior in place cast	Patient with a prior applied cast in place, when EMS personnel reached scene	67
11_Vent	Patient prior in place ventilator	Patient with a ventilatory support, when EMS personnel reached scene	67
12_CardMo	Patient prior in place cardiac monitor	Patient being monitored with cardiac monitor, When EMS personnel reached scene	67
13_NGT	Patient prior in place nasogastric tube	Patient with in placed nasogastric tube, when EMS personnel reached scene	67
14_Others	Patient prior in place others	Any Gadgets, in situ tubes or monitors in place with the patient, when EMS personnel reach the scene	67
01_skn_ho	skin hot	skin of the patient found hot	69
02_skn_wm	skin warm	skin of the patient found warm	69
03_skn_co	skin cool/cold	skin of the patient found cool/cold	69
04_skn_pl	skin pale	skin of the patient found pale	69
05_skn_pi	skin pink	skin of the patient found pink	69
06_skn_cyn	skin cyanotic	skin of the patient found cyanotic	69
07_skn_dry	skin dry	skin of the patient found dry	69
08_skn_moi	skin moist	skin of the patient found moist	69
09_skn_dph	skin diaphoretic	skin of the patient found diaphoretic ( increased perspiration)	69
01_Wtr	Reason for delay to scene weather	Reason for delay to scene being weather	70
02_Dst	Reason for delay to scene distance	Reason for delay to scene being distance to scene	70
03_WrgDir	Reason for delay to scene wrong direction	Reason for delay to scene being wrong directions	70
04_Sig	Reason for delay to scene staging	Reason for delay to scene being staging	70
05_Trf	Reason for delay to scene traffic	Reason for delay to scene being traffic	70
01_Lfefli	Reason for transport delay LifeFlight	Reason for transport delay being Life-Flight or Med-Link	71
02_PtNIR	Reason for transport delay Patient not ready	Reason for transport delay being, Patient not ready for transport	71
03_NUA	Reason for transport delay No unit available	Reason for transport delay being no unit available for transfer	71
04_CSR	Reason for transport delay confined space residence	Reason for transport delay being confined space residence	71

05_NOP	Reason for transport delay Number of patients	Reason for transport delay being, number of patients	71
06_EFV	Reason for transport delay Extrication from vehicle (jaws)	Reason for transport delay being extrication from vehicle (jaws)	71
07_OTR	Reason for transport delay Other	Reason for transport delay being other than the already optioned as mentioned	71
01_Ampu	Extremity_Amputation	If the extremity(ies) is amputated or not	79
02_Cntr	Extremity_Contracture	If there are contractures developed over any of the extremities	79
03_Edm	Extremity_edema	If there is any edema over any of the extremities	79
04_OpenWns	Extremity_Open Wounds	If there are any open wounds over the extremities	79
05_Para_R_Arm	Extremity_Paralysis_right_arm	If there is paralysis of the right arm	79
06_Para_R_Leg	Extremity_Paralysis_right_leg	If there is paralysis of the right leg	79
07_Para_L_Arm	Extremity_Paralysis_left_arm	If there is paralysis of the left arm	79
08_Para_L_Leg	Extremity_Paralysis_right_leg	If there is paralysis of the left leg	79
09_Perip_pulses	Extremity_Peripheral pulses	If the peripheral pulses over the right and left arm or leg felt...??	79
10_CR_sec	Extremity_Capillary refill	Capillary refill in extremities measured in seconds	79
11_Fxr_R_Arm	Extremity_FractureRightArm	Fracture of right arm	79
12_Fxr_Leg	Extremity_FractureRightLeg	Fracture of right leg	79
13_Fxr_Arm	Extremity_FractureLeftArm	Fracture of left arm	79
14_Fxr_Arm	Extremity_FractureLeftLeg	Fracture of left leg	79

**ALS Form code element List** – This part of the sheet includes the Code elements of the concepts present in ALS form.

Code	Code_Authoritative_Name	Code_Description	Code_Reference_Name	Code_Ref_Code	ConceptID
01	AWTY_O.P.A./N.P.A.	Airway of Oro Pharyngeal Airway or Naso Pharyngeal Airway	Liberty County EMS ALS form sheet		110
02	AWTY_E.T.T	Airway of endo tracheal tube	Liberty County EMS ALS Form sheet		110
03	AWTY_EOA/EGTA	Airway of Esophageal Obturator Airway or Esophageal Gastric Tracheal Airway	Liberty County EMS ALS Form sheet		110

Code	Code_Authoritative_Name	Code_Description	Code_Reference_Name	Code_Ref_Code	ConceptID
01_A-Fib	Illness_Symptom_Heart_Atrial Fibrillation	Patient is having atrial fibrillation or is suspected to have atrial fibrillation	Liberty County EMS Trauma Report Form		118
02_Arrhythm	Illness_Symptom_Heart_Arrhythmia	Patient is having Arrhythmia or is suspected to have arrhythmia	Liberty County EMS Trauma Report Form		118

03_Bradycard	Illness_Symptom_Heart_Bradycardia	Patient is having Bradycardia or is suspected to have bradycardia	Liberty County EMS Trauma Report Form	118
04_BBB	Illness_Symptom_Heart_Bundle_Branch_Block	Patient is having Bundle Branch Block or is suspected to have Bundle Branch Block	Liberty County EMS Trauma Report Form	118
05_CardArrest	Illness_Symptom_Heart_Cardiac_Arrest	Patient is having Cardiac Arrest	Liberty County EMS Trauma Report Form	118
06_CHF	Illness_Symptom_Congestive_Heart_Failure	Patient has congestive heart failure or is showing symptoms of congestive heart failure	Liberty County EMS Trauma Report Form	118
07_MI	Illness_Symptom_Myocardial_Infarction	Patient has Myocardia Infarction or is showing symptoms of Myocardial Infarction	Liberty County EMS Trauma Report Form	118
08_Tachycard	Illness_Symptom_Tachycardia	Patient has Tachycardia	Liberty County EMS Trauma Report Form	118
01_Pain_Head	Illness_Symptom_Pain_Head	Patient having pain in the head	Liberty County EMS Trauma Report Form	119
02_Pain_Neck	Illness_Symptom_Pain_Neck	Patient having pain in the neck	Liberty County EMS Trauma Report Form	119
03_Pain_Chest	Illness_Symptom_Pain_Chest	Patient having pain in the chest	Liberty County EMS Trauma Report Form	119
04_Pain_Breathing	Illness_Symptom_Pain_Breathing	Patient having pain while breathing	Liberty County EMS Trauma Report Form	119
05_Pain_Abdo	Illness_Symptom_Pain_Abdominal	Patient having Abdominal Pain	Liberty County EMS Trauma Report Form	119
06_Pain_Hip	Illness_Symptom_Pain_Hip	Patient having pain in the hip	Liberty County EMS Trauma Report Form	119
07_Pain_Knee	Illness_Symptom_Pain_Knee	Patient having pain in the Knee	Liberty County EMS Trauma Report Form	119
08_Pain_Leg	Illness_Symptom_Pain_Leg	Patient having pain in the Leg	Liberty County EMS Trauma Report Form	119
09_Pain_Back	Illness_Symptom_Pain_Back	Patient having pain in the Back	Liberty County EMS Trauma Report Form	119
10_Pain_Pelvic	Illness_Symptom_Pain_Pelvic	Patient having pain in the Pelvic region	Liberty County EMS Trauma Report Form	119
11_Pain_Rib	Illness_Symptom_Pain_Rib	Patient having pain in the Rib	Liberty County EMS Trauma Report Form	119
12_Pain_Shoulder	Illness_Symptom_Pain_Shoulder	Patient having pain in the Shoulder region	Liberty County EMS Trauma Report Form	119
01_CerebrEmblus	Illness_Symptom_Cerebrovascular_Cerebral_Embolus	Patient is known to have cerebral embolus or is suspected to have cerebral embolus	Liberty County EMS Trauma Report Form	120

02_CerebrlHemorr	Illness_Symptom_Cerebrovascular_Cerebral_Hemorrhage	Patient is known to have cerebral haemorrhage or is suspected to have cerebral haemorrhage	Liberty County EMS Trauma Report Form	120
03_CerebrlIsche	Illness_Symptom_Cerebrovascular_Cerebral_Ischemia	Patient is known to have cerebral ischemia or is suspected to have cerebral ischemia	Liberty County EMS Trauma Report Form	120
04_Cerebrovas_CVA	Illness_Symptom_Cerebrovascular_Cerebrovascul_ar_Attack	Patient is known to have had a cerebrovascular attack or is suspected to have a cerebrovascular attack	Liberty County EMS Trauma Report Form	120
05_Cerebrovas_HTN	Illness_Symptom_Cerebrovascular_Hypertension	Patient is known to have hypertension or is having hypertension	Liberty County EMS Trauma Report Form	120
06_Cerebrovas_Hypoten	Illness_Symptom_Cerebrovascular_Hypotension	Patient is known to have hypotension or is suspected to have hypotension	Liberty County EMS Trauma Report Form	120
01_InfecDis_DecubUlcer	Illness_Symptom_Infectious_Disease_Decubitus_Ulcer	Patient is known to have decubitus ulcer or is suspected to have decubitus ulcer	Liberty County EMS Trauma Report Form	121
02_InfecDis_Hepatitis	Illness_Symptom_Infectious_Disease_Hepatitis	Patient is known to have Hepatitis or is suspected to have Hepatitis	Liberty County EMS Trauma Report Form	121
03_InfecDis_HIV	Illness_Symptom_Infectious_Disease_Human_Immunodeficiency_Virus	Patient is known to have Human Immunodeficiency Virus or is suspected to have Human Immunodeficiency Virus	Liberty County EMS Trauma Report Form	121
04_InfecDis_AIDS	Illness_Symptom_Infectious_Disease_Aquired_Immunodeficiency_Syndrome	Patient is known to have Aquired Immunodeficiency Syndrome or is suspected to have Aquired Immunodeficiency Syndrome	Liberty County EMS Trauma Report Form	121
05_InfecDis_Mengitis	Illness_Symptom_Infectious_Disease_Meningitis	Patient is known to have Meningitis or is suspected to have Meningitis	Liberty County EMS Trauma Report Form	121
06_InfecDis_MRSA	Illness_Symptom_Infectious_Disease_MRSA	Patient is known to have Meningitis or is suspected to have Meningitis	Liberty County EMS Trauma Report Form	121
07_InfecDis_TB	Illness_Symptom_Infectious_Disease_Tuberculosis	Patient is known to have Tuberculosis or is suspected to have Tuberculosis	Liberty County EMS Trauma Report Form	121
08_InfecDis_ESRD	Illness_Symptom_Infectious_Disease_ESRD	Patient is known to have Tuberculosis or is suspected to have Tuberculosis	Liberty County EMS Trauma Report Form	121
01_Sezu_ActSeiz	Illness_Symptom_Seizure_Active_Seizures	Patient is known to have Active Seizures or is suspected to have Active Seizures	Liberty County EMS Trauma Report Form	122
02_Sezu_BrnTumr	Illness_Symptom_Seizure_Brain_Tumor	Patient is known to have Brain Tumor or is suspected to have Brain Tumor	Liberty County EMS Trauma Report Form	122
03_Sezu_Convulsns	Illness_Symptom_Seizure_Convulsions	Patient is known to have Convulsions or is suspected to have Convulsions	Liberty County EMS Trauma Report Form	122
04_Sezu_GrndMalSeiz	Illness_Symptom_Seizure_Grand_Mal_Seizures	Patient is known to have Grand Mal Seizures or is suspected to have Grand Mal Seizures	Liberty County EMS Trauma Report Form	122

01_Lung_COPD	Illness_Symptom_Lung_Chronic obstructive pulmonary disease	Patient is known to have Chronic obstructive pulmonary disease or is suspected to have Chronic obstructive pulmonary disease	Liberty County EMS Trauma Report Form	123
02_Lung_PulmEdema	Illness_Symptom_Lung_Pulmonary edema	Patient is known to have Pulmonary edema or is suspected to have Pulmonary edema	Liberty County EMS Trauma Report Form	123
03_Lung_PulmEmbolism	Illness_Symptom_Lung_Pulmonary embolism	Patient is known to have Pulmonary embolism or is suspected to have Pulmonary embolism	Liberty County EMS Trauma Report Form	123
01_Diabets_DbetsAcidosis	Illness_Symptom_Diabetic_Diabetic Acidosis	Patient is known to have Diabetic Acidosis or is suspected to have Diabetic Acidosis	Liberty County EMS Trauma Report Form	124
02_Diabets_DbetcComa	Illness_Symptom_Diabetic_Diabetic Coma	Patient is known to have Diabetic Coma or is suspected to have Diabetic Coma	Liberty County EMS Trauma Report Form	124
03_Diabets_DbetsUncontrl	Illness_Symptom_Diabetic_Diabetes Uncontrolled	Patient is known to have Diabetes Uncontrolled or is suspected to have Diabetes Uncontrolled	Liberty County EMS Trauma Report Form	124
04_Diabets_NIDDM	Illness_Symptom_Diabetic_Non-Insulin dependant diabetes mellitus	Patient is known to have Non-Insulin dependant diabetes mellitus or is suspected to have Non-Insulin dependant diabetes mellitus	Liberty County EMS Trauma Report Form	124
05_Diabets_IDDM	Illness_Symptom_Diabetic_Insulin dependant diabetes mellitus	Patient is known to have Insulin dependant diabetes mellitus or is suspected to have Insulin dependant diabetes mellitus	Liberty County EMS Trauma Report Form	124
01_InjryTy_Bum	Illness_Symptom_Injury Type_Bum	Patient is known to have burn injury or is suspected to have burn injury	Liberty County EMS Trauma Report Form	125
02_InjryTy_Dislocn	Illness_Symptom_Injury Type_Dislocation	Patient is known to have dislocation injury or is suspected to have dislocation injury	Liberty County EMS Trauma Report Form	125
03_InjryTy_Fracture	Illness_Symptom_Injury Type_Fracture	Patient is known to have fracture or is suspected to have fracture	Liberty County EMS Trauma Report Form	125
04_InjryTy_Head	Illness_Symptom_Injury Type_Head	Patient is known to have head injury or is suspected to have head injury	Liberty County EMS Trauma Report Form	125
05_InjryTy_Intml	Illness_Symptom_Injury Type_Internal	Patient is known to have internal injury or is suspected to have internal injury	Liberty County EMS Trauma Report Form	125
06_InjryTy_Lacrain	Illness_Symptom_Injury Type_Laceration	Patient is known to have laceration injury or is suspected to have laceration injury	Liberty County EMS Trauma Report Form	125
07_InjryTy_Spine	Illness_Symptom_Injury Type_Spine	Patient is known to have spine injury or is suspected to have spine injury	Liberty County EMS Trauma Report Form	125
08_InjryTy_Choke	Illness_Symptom_Injury Type_Choke	Patient is known to have choke injury or is suspected to have choke injury	Liberty County EMS Trauma Report Form	125
09_InjryTy_Sprain	Illness_Symptom_Injury Type_Sprain	Patient is known to have sprain injury or is suspected to have sprain injury	Liberty County EMS Trauma Report Form	125

10_InjuryTy_Hematoma	Illness_Symptom_Injury_Type_Hematoma	Patient is known to have hematoma or is suspected to have hematoma	Liberty County EMS Trauma Report Form	125
01	Illness_Symptom_Injury_Place_of_occurrence_Farm	The patient sustained the injury at a farm	Liberty County EMS Trauma Report Form	126
02	Illness_Symptom_Injury_Place_of_occurrence_Home	The patient sustained the injury at home	Liberty County EMS Trauma Report Form	126
03	Illness_Symptom_Injury_Place_of_occurrence_Highway	The patient sustained the injury on a highway	Liberty County EMS Trauma Report Form	126
04	Illness_Symptom_Injury_Place_of_occurrence_Industrial	The patient sustained the injury at industrial place	Liberty County EMS Trauma Report Form	126
05	Illness_Symptom_Injury_Place_of_occurrence_Mine	The patient sustained the injury at a mine	Liberty County EMS Trauma Report Form	126
06	Illness_Symptom_Injury_Place_of_occurrence_Recreational	The patient sustained the injury at a recreational place	Liberty County EMS Trauma Report Form	126
07	Illness_Symptom_Injury_Place_of_occurrence_Street	The patient sustained the injury on a street	Liberty County EMS Trauma Report Form	126
08	Illness_Symptom_Injury_Place_of_occurrence_PublicBuilding	The patient sustained the injury on public building	Liberty County EMS Trauma Report Form	126
01_Cncer_Debilitating	Illness_Symptom_Cancer_Debilitating	Patient is known to have debilitating cancer or is suspected to have a debilitating cancer	Liberty County EMS Trauma Report Form	127
02_Cncer_Metast	Illness_Symptom_Cancer_Metastatic	Patient is known to have metastatic cancer or is suspected to have a metastatic cancer	Liberty County EMS Trauma Report Form	127
03_Cncer_Terminal	Illness_Symptom_Cancer_Terminal	Patient is known to have terminal cancer or is suspected to have a terminal cancer	Liberty County EMS Trauma Report Form	127
04_Cncer_Typ	Illness_Symptom_Cancer_Type	Mention the type of cancer if known	Liberty County EMS Trauma Report Form	127
01_Gastrintes_Blding	Illness_Symptom_Gastrointestinal_Bleeding	Patient is known to have gastrointestinal bleeding or is suspected to have gastrointestinal bleeding	Liberty County EMS Trauma Report Form	128
02_Gastrintes_GBAttack	Illness_Symptom_Gastrointestinal_Gall_Bladder_Attack	Patient is known to have gall bladder attack or is suspected to have gall bladder attack	Liberty County EMS Trauma Report Form	128
03_Gastrintes_IntstnlObstruct	Illness_Symptom_Gastrointestinal_Intestinal_Obstruction	Patient is known to have intestinal obstruction or is suspected to have intestinal obstruction	Liberty County EMS Trauma Report Form	128
01_Resp_Astma	Illness_Symptom_Respiratory_Astama	Patient is known to have asthma or is suspected to have asthma	Liberty County EMS Trauma Report Form	129
02_Resp_Choking	Illness_Symptom_Respiratory_Choking	Patient is known to have choking or is suspected to have choking	Liberty County EMS Trauma Report Form	129

03_Resp_DiffBirthing	Illness_Symptom_Respiratory_Difficult Breathing	Patient is known to have difficult breathing or is suspected to have difficult breathing	Liberty County EMS Trauma Report Form	129
04_Resp_Emphysm	Illness_Symptom_Respiratory_Emphysema	Patient is known to have emphysema or is suspected to have emphysema	Liberty County EMS Trauma Report Form	129
05_Resp_EsophgObst	Illness_Symptom_Respiratory_Esophageal Obstruction	Patient is known to have esophageal obstruction or is suspected to have esophageal obstruction	Liberty County EMS Trauma Report Form	129
06_Resp_RespDistrs	Illness_Symptom_Respiratory_Respiratory Distress	Patient is known to have respiratory distress or is suspected to have respiratory distress	Liberty County EMS Trauma Report Form	129
01_AlterMentSta_Anxiety	Illness_Symptom_Altered Mental State_Anxiety	Patient is known to have anxiety or is suspected to have anxiety	Liberty County EMS Trauma Report Form	130
02_AlterMentSta_DOA	Illness_Symptom_Altered Mental State_DOA	Patient is known to have ?? or is suspected to have ??	Liberty County EMS Trauma Report Form	130
03_AlterMentSta_SemiCons	Illness_Symptom_Altered Mental State_Semi Conscious	Patient is known to be in a semi-conscious state or is suspected to be in semi-conscious state	Liberty County EMS Trauma Report Form	130
04_AlterMentSta_Shock	Illness_Symptom_Altered Mental State_Shock	Patient is known to be in a state of shock or is suspected to be in a state of shock	Liberty County EMS Trauma Report Form	130
05_AlterMentSta_Uncons	Illness_Symptom_Altered Mental State_Uncons	Patient is known to be in an unconscious state or is suspected to be in unconscious state	Liberty County EMS Trauma Report Form	130
06_AlterMentSta_Violent	Illness_Symptom_Altered Mental State_Violent	Patient is known to be in a violent state or is suspected to be in violent state	Liberty County EMS Trauma Report Form	130
807	Trauma Information_Probable Cause_Transport_Railway crash not incl. Motor Vehicle Accident	The probable cause of trauma is railway crash not including motor vehicle accident (?MVA)	Liberty County EMS Trauma Report Form	132
819	Trauma Information_Probable Cause_Transport_Motor vehicle traffic crash	The probable cause of trauma is motor vehicle traffic crash	Liberty County EMS Trauma Report Form	132
825	Trauma Information_Probable Cause_Transport_Motor vehicle non-traffic crash	The probable cause of trauma is motor vehicle non-traffic crash	Liberty County EMS Trauma Report Form	132
829	Trauma Information_Probable Cause_Transport_Other vehicle crash without motors	The probable cause of trauma is other vehicle crash without motors	Liberty County EMS Trauma Report Form	132
838	Trauma Information_Probable Cause_Transport_Water transport crash	The probable cause of trauma is water transport crash	Liberty County EMS Trauma Report Form	132
844	Trauma Information_Probable Cause_Transport_Air transport crash	The probable cause of trauma is air transport crash	Liberty County EMS Trauma Report Form	132
0	Trauma Information_Probable Cause_Transport_Code_Subcode_Driver, not motorcycle	The probable cause of trauma is related to transport and involves driver of non-motorcycle vehicle	Liberty County EMS Trauma Report Form	133

.1	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Passenger, not motorcycle	The probable cause of trauma is related to transport and involves passenger of non-motorcycle vehicle	Liberty County EMS Trauma Report Form	133
.2	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Driver, motorcycle	The probable cause of trauma is related to transport and involves driver of a motorcycle vehicle	Liberty County EMS Trauma Report Form	133
.3	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Passenger, motorcycle	The probable cause of trauma is related to transport and involves passenger of a motorcycle vehicle	Liberty County EMS Trauma Report Form	133
.6	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Pedal cyclist	The probable cause of trauma is related to transport and involves pedal cyclist	Liberty County EMS Trauma Report Form	133
.8	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Pedestrian	The probable cause of trauma is related to transport and involves pedestrian	Liberty County EMS Trauma Report Form	133
.9	Trauma_Information_Probable_Cause_Transport_Code_Subcode_Other/unspecified person	The probable cause of trauma is related to transport and involves unspecified person, other than listed in above codes	Liberty County EMS Trauma Report Form	133
858	Trauma_Information_Probable_Cause_OtherCauses_Poisoning drugs/meds/alcohol	The probable cause of trauma is Poisoning due to drug(s) or medicine(s) or alcohol	Liberty County EMS Trauma Report Form	134
866	Trauma_Information_Probable_Cause_OtherCauses_Poisoning other solids/liquids	The probable cause of trauma is Poisoning due to other solids/liquids (other than drug(s) or medicine(s) or alcohol)	Liberty County EMS Trauma Report Form	134
869	Trauma_Information_Probable_Cause_OtherCauses_Poisoning other gases/vapors	The probable cause of trauma is Poisoning due to other gases or vapors	Liberty County EMS Trauma Report Form	134
884	Trauma_Information_Probable_Cause_OtherCauses_fall from one level to another	The probable cause of trauma is fall from one level to another	Liberty County EMS Trauma Report Form	134
886	Trauma_Information_Probable_Cause_OtherCauses_fall on same street level	The probable cause of trauma is fall on same street level	Liberty County EMS Trauma Report Form	134
890	Trauma_Information_Probable_Cause_OtherCauses_fire flames/heat	The probable cause of trauma is fire flames/heat	Liberty County EMS Trauma Report Form	134
891	Trauma_Information_Probable_Cause_OtherCauses_fire smoke/fumes	The probable cause of trauma is fire smoke/fumes	Liberty County EMS Trauma Report Form	134
892	Trauma_Information_Probable_Cause_OtherCauses_fire explosion/collapse	The probable cause of trauma is fire related exploded/collapse	Liberty County EMS Trauma Report Form	134
E893	Trauma_Information_Probable_Cause_OtherCauses_fire clothing ignition only	The probable cause of trauma is fire related clothing ignition only	Liberty County EMS Trauma Report Form	134
E900	Trauma_Information_Probable_Cause_OtherCauses_Environment excessive heat	The probable cause of trauma is excessive environmental heat	Liberty County EMS Trauma Report Form	134

E901	Trauma Information_Probable Cause_OtherCauses_Environment excessive cold	The probable cause of trauma is excessive environmental cold	Liberty County EMS Trauma Report Form	134
E904	Trauma Information_Probable Cause_OtherCauses_Hunger/thirst/exposure/neglect	The probable cause of trauma is related to hunger/thirst/exposure/neglect	Liberty County EMS Trauma Report Form	134
E905	Trauma Information_Probable Cause_OtherCauses_Venomous animals/plants	The probable cause of trauma is related to exposure to venomous animals or plants	Liberty County EMS Trauma Report Form	134
E906	Trauma Information_Probable Cause_OtherCauses_Bites/injuries non-venomous animal	The probable cause of trauma is related to bite or injury by a non-venomous animal	Liberty County EMS Trauma Report Form	134
E907	Trauma Information_Probable Cause_OtherCauses_Lightening	The probable cause of trauma is related to lightning	Liberty County EMS Trauma Report Form	134
E908	Trauma Information_Probable Cause_OtherCauses_Storms/flood	The probable cause of trauma is related to storms or flood	Liberty County EMS Trauma Report Form	134
E909	Trauma Information_Probable Cause_OtherCauses_Earth movements/tidal waves	The probable cause of trauma is related to earth movements or tidal waves	Liberty County EMS Trauma Report Form	134
E910	Trauma Information_Probable Cause_OtherCauses_Drowning/submersion	The probable cause of trauma is related to drowning or submersion	Liberty County EMS Trauma Report Form	134
E913	Trauma Information_Probable Cause_OtherCauses_Hanging/strangulation/suffocation	The probable cause of trauma is related to Hanging /strangulation/suffocation	Liberty County EMS Trauma Report Form	134
E917	Trauma Information_Probable Cause_OtherCauses_Hit by person or object : unintentional vehicle/weapons/machinery involved	The probable cause of trauma is related to hit by person or object with unintentional vehicle/weapons /machinery involved	Liberty County EMS Trauma Report Form	134
911	Trauma Information_Probable Cause_OtherCauses_Airway obstruction: object inhaled/ingested	The probable cause of trauma is related to Airway obstruction: object inhaled/ingested	Liberty County EMS Trauma Report Form	134
E919	Trauma Information_Probable Cause_OtherCauses_Machinery: not vehicle	The probable cause of trauma is related to machinery and not involving vehicle	Liberty County EMS Trauma Report Form	134
E920	Trauma Information_Probable Cause_OtherCauses_Cutting/piercing/stabbing	The probable cause of trauma is related to cutting/piercing or stabbing	Liberty County EMS Trauma Report Form	134
E921	Trauma Information_Probable Cause_OtherCauses_Explosion of boiler/pressure vessel	The probable cause of trauma is related to explosion of boiler or a pressure vessel	Liberty County EMS Trauma Report Form	134
E922	Trauma Information_Probable Cause_OtherCauses_Firearms	The probable cause of trauma is related to firearms	Liberty County EMS Trauma Report Form	134

E923	Trauma Information_Probable Cause_OtherCauses_Explosive material: blast with or w/o flash time	The probable cause of trauma is related to explosion material with blast with or without flash time	Liberty County EMS Trauma Report Form	134
E924	Trauma Information_Probable Cause_OtherCauses_Caustics/corrosives/steam/hot liquid	The probable cause of trauma is related to caustics/corrosives/steam or hot liquid	Liberty County EMS Trauma Report Form	134
E925	Trauma Information_Probable Cause_OtherCauses_Electrocution	The probable cause of trauma is related to electrocution	Liberty County EMS Trauma Report Form	134
E926	Trauma Information_Probable Cause_OtherCauses_Radioactive material	The probable cause of trauma is related to radioactive material	Liberty County EMS Trauma Report Form	134
E960	Trauma Information_Probable Cause_OtherCauses_Assault: fight/brawl/battery	The probable cause of trauma is related to assault involving a fight/brawl/battery	Liberty County EMS Trauma Report Form	134
E961	Trauma Information_Probable Cause_OtherCauses_Suspected rape/sexual assault	The probable cause of trauma is related to suspected rape/sexual assault	Liberty County EMS Trauma Report Form	134
0.1	Trauma Information_Probable Cause_Other Causes_Code_Subcode_Accidental causes	The probable cause of trauma is related to causes other than transport and also involves accidental causes	Liberty County EMS Trauma Report Form	135
0.2	Trauma Information_Probable Cause_Other Causes_Code_Subcode_Self-inflicted cause	The probable cause of trauma is related to causes other than transport and also involves self-inflicted cause	Liberty County EMS Trauma Report Form	135
0.9	Trauma Information_Probable Cause_Other Causes_Code_Subcode_Legal intervention by law officer	The probable cause of trauma is related to causes other than transport and also involves legal intervention by law officer	Liberty County EMS Trauma Report Form	135
1.2	Trauma Information_Probable Cause_Other Causes_Code_Subcode_other inflicted causes	The probable cause of trauma is related to causes other than transport and also involves other-inflicted causes	Liberty County EMS Trauma Report Form	135
01	Trauma Information_Preventive Aid_None	No preventive aid was being used at the time of trauma	Liberty County EMS Trauma Report Form	136
02	Trauma Information_Preventive Aid_Seatbelt/Shoulder harness	Seatbelt or shoulder harness was being used as preventive aid at the time of trauma	Liberty County EMS Trauma Report Form	136
03	Trauma Information_Preventive Aid_Airbag&belt	Airbag & belt were being used as preventive aid at the time of trauma	Liberty County EMS Trauma Report Form	136
04	Trauma Information_Preventive Aid_Child Restraints	Child restraints were being used as preventive aid at the time of trauma	Liberty County EMS Trauma Report Form	136
05	Trauma Information_Preventive Aid_Protective helmets	Protective helmets were being used as preventive aid at the time of trauma	Liberty County EMS Trauma Report Form	136
06	Trauma Information_Preventive Aid_Padding and/or protective cloths	Padding and/or protective cloths were being used as preventive aid at the time of trauma	Liberty County EMS Trauma Report Form	136

01	<b>Trauma Information_Aid prior to Arrival_No</b>	No aid was available to the patient, prior to arrival of EMS personnel	Liberty County EMS Trauma Report Form	137
02	<b>Trauma Information_Aid prior to Arrival_Yes, CPR only</b>	Only CPR was available to the patient as aid, prior to arrival of EMS personnel	Liberty County EMS Trauma Report Form	137
03	<b>Trauma Information_Aid prior to Arrival_Yes, CPR/AED only</b>	CPR/AED only, was available to the patient as aid, prior to arrival of EMS personnel	Liberty County EMS Trauma Report Form	137
04	<b>Trauma Information_Aid prior to Arrival_Yes, AED only</b>	Only AED was available to the patient as aid, prior to arrival of EMS personnel	Liberty County EMS Trauma Report Form	137
01	<b>Trauma Information_Injury Type_Burn</b>	The patient is having burn injury	Liberty County Trauma Report Form	138
02	<b>Trauma Information_Injury Type_Fracture</b>	The patient is having fracture injury	Liberty County Trauma Report Form	138
03	<b>Trauma Information_Injury Type_Dislocation</b>	The patient is having dislocation injury	Liberty County Trauma Report Form	138
04	<b>Trauma Information_Injury Type_Laceration</b>	The patient is having laceration injury	Liberty County Trauma Report Form	138
05	<b>Trauma Information_Injury Type_Penetration</b>	The patient is having penetration injury	Liberty County Trauma Report Form	138
06	<b>Trauma Information_Injury Type_Internal</b>	The patient is having internal injury	Liberty County Trauma Report Form	138
07	<b>Trauma Information_Injury Type_Blunt</b>	The patient is having blunt injury	Liberty County Trauma Report Form	138
08	<b>Trauma Information_Injury Type_Drown</b>	The patient's injury(s) is related to drowning	Liberty County Trauma Report Form	138
09	<b>Trauma Information_Injury Type_Suffocate</b>	The patient's injury(s) is related to suffocation	Liberty County Trauma Report Form	138
10	<b>Trauma Information_Injury Type_Choke</b>	The patient's injury(s) is related to choking	Liberty County Trauma Report Form	138
11	<b>Trauma Information_Injury Type_Drug Overdose</b>	The patient's injury(s) is related to drug overdose	Liberty County Trauma Report Form	138
12	<b>Trauma Information_Injury Type_Acute Alcohol Intoxication</b>	The patient's injury(s) is related to acute alcohol intoxication	Liberty County Trauma Report Form	138
13	<b>Trauma Information_Injury Type_Spine Injury</b>	The patient is having spine injury	Liberty County Trauma Report Form	138
14	<b>Trauma Information_Injury Type_Brain Injury</b>	The patient is having brain injury	Liberty County Trauma Report Form	138
15	<b>Trauma Information_Injury Type_Scrape</b>	The patient is having scrape injury	Liberty County Trauma Report Form	138
16	<b>Trauma Information_Injury Type_Bruise</b>	The patient is having bruise injury	Liberty County Trauma Report Form	138
17	<b>Trauma Information_Injury Type_Cut</b>	The patient is having cut injury	Liberty County Trauma Report Form	138

18	Trauma Information_Injury Type_Sprain	The patient is having sprain injury	Liberty County Trauma Report Form	138
19	Trauma Information_Injury Type_Strain	The patient is having strain injury	Liberty County Trauma Report Form	138
20	Trauma Information_Injury Type_Amputation	The patient is having amputation injury	Liberty County Trauma Report Form	138
21	Trauma Information_Injury Type_Avulsion	The patient is having avulsion injury	Liberty County Trauma Report Form	138
01	Trauma Information_Injury Severity_Possible	The patient's injury is of 'possible' severity (?)	Liberty County Trauma Report Form	139
02	Trauma Information_Injury Severity_Non-incapacitating	The patient's injury is of 'non-incapacitating' severity	Liberty County Trauma Report Form	139
03	Trauma Information_Injury Severity_Incapacitating	The patient's injury is of 'incapacitating' severity	Liberty County Trauma Report Form	139
01	Trauma Information_Injury Location_Area_01	The injury of the patient is located in area 1 defined as 'right fronto-parietal region of the scalp, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
02	Trauma Information_Injury Location_Area_02	The injury of the patient is located in area 2 defined as 'area on right side of the face, between hairline and horizontal plane at root of nose, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
03	Trauma Information_Injury Location_Area_03	The injury of the patient is located in area 3 defined as 'area on right side of the face, between horizontal line at root of nose and lower mandibular border, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
04	Trauma Information_Injury Location_Area_04	The injury of the patient is located in area 4 defined as 'area on right side of the neck, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
05	Trauma Information_Injury Location_Area_05	The injury of the patient is located in area 5 defined as 'area on right side of the chest below right clavicle to the horizontal line at the level of nipples, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
06	Trauma Information_Injury Location_Area_06	The injury of the patient is located in area 6 defined as 'area on right side of the chest below the horizontal line at the level of nipples to the horizontal line at the level of umbilicus, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140

07	Trauma Information_Injury_Injury Location_Area 7	The injury of the patient is located in a area 7 defined as 'area below the horizontal line at the level of umbilicus to the line joining right superior iliac spine and pubic symphysis, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
08	Trauma Information_Injury_Injury Location_Area 8	The injury of the patient is located in a area 8 defined by right arm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
09	Trauma Information_Injury_Injury Location_Area 9	The injury of the patient is located in a area 9 defined by right forearm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
10	Trauma Information_Injury_Injury Location_Area 10	The injury of the patient is located in a area 10 defined by right palm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
11	Trauma Information_Injury_Injury Location_Area 11	The injury of the patient is located in a area 11 defined by right thigh in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
12	Trauma Information_Injury_Injury Location_Area 12	The injury of the patient is located in a area 12 defined by right knee in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
13	Trauma Information_Injury_Injury Location_Area 13	The injury of the patient is located in a area 13 defined by a horizontal line below right knee to a horizontal line above the right ankle joint, in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
14	Trauma Information_Injury_Injury Location_Area 14	The injury of the patient is located in a area 14 defined by right ankle joint in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
15	Trauma Information_Injury_Injury Location_Area 15	The injury of the patient is located in a area 15 defined by dorsum of right foot, in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
16	Trauma Information_Injury_Injury Location_Area 16	The injury of the patient is located in a area 16 defined as 'left fronto-parietal region of the scalp, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
17	Trauma Information_Injury_Injury Location_Area 17	The injury of the patient is located in a area 17 defined as 'area on left side of the face, between hairline and horizontal plane at root of nose, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
18	Trauma Information_Injury_Injury Location_Area 18	The injury of the patient is located in a area 18 defined as 'area on left side of the face, between horizontal line at root of nose and lower mandibular border, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140

19	Trauma_Information_Injury_Injury_Location_Area_19	The injury of the patient is located in area 19 defined as 'area on left side of the neck, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
20	Trauma_Information_Injury_Injury_Location_Area_20	The injury of the patient is located in area 20 defined as 'area on right side of the chest below left clavicle to the horizontal line at the level of nipples, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
21	Trauma_Information_Injury_Injury_Location_Area_21	The injury of the patient is located in area 21 defined as 'area on left side of the chest below the horizontal line at the level of nipples to the horizontal line at the level of umbilicus, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
22	Trauma_Information_Injury_Injury_Location_Area_22	The injury of the patient is located in area 22 defined as 'area below the horizontal line at the level of umbilicus to to the line joining left superior iliac spine and pubic symphysis, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
23	Trauma_Information_Injury_Injury_Location_Area_23	The injury of the patient is located in area 23 defined by left arm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
24	Trauma_Information_Injury_Injury_Location_Area_24	The injury of the patient is located in area 24 defined by left forearm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
25	Trauma_Information_Injury_Injury_Location_Area_25	The injury of the patient is located in area 25 defined by left palm in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
26	Trauma_Information_Injury_Injury_Location_Area_26	The injury of the patient is located in area 26 defined by left thigh in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
27	Trauma_Information_Injury_Injury_Location_Area_27	The injury of the patient is located in area 27 defined by left knee in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
28	Trauma_Information_Injury_Injury_Location_Area_28	The injury of the patient is located in area 28 defined by a horizontal line below left knee to a horizontal line above the left ankle joint, in supine position	Liberty County Trauma Report Form Injury Location Diagram	140
29	Trauma_Information_Injury_Injury_Location_Area_29	The injury of the patient is located in area 29 defined by left ankle joint in supine position	Liberty County Trauma Report Form Injury Location Diagram	140

30	<b>Trauma Information_Injury_Location_Area 30</b>	The injury of the patient is located in area 30 defined by 'dorsum of right foot, in supine position'	Liberty County Trauma Report Form Injury Location Diagram	140
31	<b>Trauma Information_Injury_Location_Area 31</b>	The injury of the patient is located in area 31 defined by 'area of the scalp on left side of midline (left occipital region) in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
32	<b>Trauma Information_Injury_Location_Area 32</b>	The injury of the patient is located in area 32 defined by 'area of neck on left side of midline in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
33	<b>Trauma Information_Injury_Location_Area 33</b>	The injury of the patient is located in area 33 defined by 'area of back on left side of midline, below the neck to the line defined by lower border of rib cage, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
34	<b>Trauma Information_Injury_Location_Area 34</b>	The injury of the patient is located in area 34 defined by 'area of back on left side of midline, below the line defined by lower border of rib cage to the upper border of pelvis, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
35	<b>Trauma Information_Injury_Location_Area 35</b>	The injury of the patient is located in area 35 defined by 'area on left side of midline, below the line defined by upper border of pelvis to the gluteal fold, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
36	<b>Trauma Information_Injury_Location_Area 36</b>	The injury of the patient is located in area 36 defined by 'area of left arm in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
37	<b>Trauma Information_Injury_Location_Area 37</b>	The injury of the patient is located in area 37 defined by 'area of left elbow in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
38	<b>Trauma Information_Injury_Location_Area 38</b>	The injury of the patient is located in area 38 defined by 'area of left forearm in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
39	<b>Trauma Information_Injury_Location_Area 39</b>	The injury of the patient is located in area 38 defined by 'area of dorsal surface of left hand, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
40	<b>Trauma Information_Injury_Location_Area 40</b>	The injury of the patient is located in area 40 defined by 'area of left thigh, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140

41	Trauma_Information_Injury_Injury_Location_Area_41	The injury of the patient is located in area 41 defined by 'area of left calf, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
42	Trauma_Information_Injury_Injury_Location_Area_42	The injury of the patient is located in area 42 defined by 'area of left ankle joint, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
43	Trauma_Information_Injury_Injury_Location_Area_43	The injury of the patient is located in area 43 defined by 'area of plantar aspect of left foot, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
44	Trauma_Information_Injury_Injury_Location_Area_44	The injury of the patient is located in area 44 defined by 'area of the scalp on right side of midline (right occipital region) in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
45	Trauma_Information_Injury_Injury_Location_Area_45	The injury of the patient is located in area 45 defined by 'area of neck on right side of midline, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
46	Trauma_Information_Injury_Injury_Location_Area_46	The injury of the patient is located in area 46 defined by 'area of back, on right side of midline, below the neck to the line defined by lower border of rib cage, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
47	Trauma_Information_Injury_Injury_Location_Area_47	The injury of the patient is located in area 47 defined by 'area of back on right side of midline, below the line defined by lower border of rib cage to the upper border of pelvis, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
48	Trauma_Information_Injury_Injury_Location_Area_48	The injury of the patient is located in area 48 defined by 'area on right side of midline, below the line defined by upper border of pelvis to the gluteal fold, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
49	Trauma_Information_Injury_Injury_Location_Area_49	The injury of the patient is located in area 49 defined by 'area of right arm in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
50	Trauma_Information_Injury_Injury_Location_Area_50	The injury of the patient is located in area 50 defined by 'area of right elbow in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
51	Trauma_Information_Injury_Injury_Location_Area_51	The injury of the patient is located in area 51 defined by 'area of right forearm in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140

52	Trauma Information_Injury_Injury Location_Area 52	The injury of the patient is located in area 52 defined by 'area of dorsal surface of left hand, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
53	Trauma Information_Injury_Injury Location_Area 53	The injury of the patient is located in area 53 defined by 'area of right thigh, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
54	Trauma Information_Injury_Injury Location_Area 54	The injury of the patient is located in area 54 defined by 'area of right calf, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
55	Trauma Information_Injury_Injury Location_Area 55	The injury of the patient is located in area 55 defined by 'area of right ankle joint, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140
56	Trauma Information_Injury_Injury Location_Area 56	The injury of the patient is located in area 57 defined by 'area of plantar aspect of right foot, in prone position of the body'	Liberty County Trauma Report Form Injury Location Diagram	140

**Patient Charge Sheet code element List** – This part of the sheet includes the Code elements of the concepts present in Patient charge sheet.

Code	Code_Authoritative_Name	Code_Description	Code_Refernce_Cd	Code_ConceptID
01_Trans_HoliCall	Transport / No Transport_Holiday call	If the call for the ambulance was during a holiday, charge for holiday call		148
02_Trans_NgtCall	Transport / No Transport_Night call	If the ambulance call is a night call, charge for night call		148
03_Trans_RegCl	Transport / No Transport_Regular Call	charge for a ambulance call of Regular type		148
04_Trans_WkndCl	Transport / No Transport_Weekend Call	charge for a ambulance call which falls on a weekend		148
01_Bnket	Routine Supplies_Banket	blankets used by the patient		156
02_NSGiv	Routine Supplies Non Sterile Gloves	Non-Sterile gloves used by the patient		156
03_Plow/cse	Routine Supplies_Pillow / Pillow Case	Pillows used or supplied/ with or without pillow cases		156
04_PuOxy	Routine Supplies_Pulse Oxymetry	pulseoximetry used for the patient?		156
05_Sht	Routine Supplies_Sheets	sheets used for the patient		156
06_Twl	Routine Supplies_Towels	Towels used for the patient		156
01_Oxy	Airway Maintenance_Oxygen	oxygen used for the patient, also documenting liters oxygen supplied as @ _____ LPM (Liters per minute)		163
02_NsalCanu_adult	Airway Maintenance_Nasal Cannula_Adult	nasal cannula used for airway maintenance of a Adult patient.		163
03_NsalCanu_Pedi	Airway Maintenance_Nasal Cannula_Pediatrics	nasal cannula used for airway maintenance of a pediatric patient.		163

04_SpmMsk_	Airway Maintenance_Simple Mask	Simple Masks used for airway maintenance of the patient. Also documenting if it was adult size or pediatric size	163
05_Nrebrether	Airway Maintenance_Non-Rebreather	Non-rebreather used for airway maintenance of the patient. Also documenting if it was adult size or pediatric size If a Nebulizer is used for airway maintenance of the patient	163
06_Nebuz	Airway Maintenance_Nebulizer	If a Nebulizer is used for airway maintenance of the patient	163
07_Humif	Airway Maintenance_Humidifier	If a Humidifier is used for airway maintenance of the patient	163
08_O2Tu	Airway Maintenance_O2 Tubing	O2 tubing used for airway maintenance of the patient	163
09_BVm	Airway Maintenance_BVM	bag valve mask is used for airway maintenance of the patient. Also documenting whether it was Adult Type or Children Type or Pediatric Type	163
10_ETT_3	Airway Maintenance_Endo Tracheal Tube_3	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_4	Airway Maintenance_Endo Tracheal Tube_4	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_5	Airway Maintenance_Endo Tracheal Tube_5	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_6	Airway Maintenance_Endo Tracheal Tube_6	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_7	Airway Maintenance_Endo Tracheal Tube_7	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_8	Airway Maintenance_Endo Tracheal Tube_8	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
10_ETT_9	Airway Maintenance_Endo Tracheal Tube_9	If an endo tracheal tube(size indicated) is used for airway maintenance of the patient	163
11_ETSty_pedi	Airway Maintenance_Endo Tracheal Stylet_pedi	If endo tracheal stylet(pediatric)is used for airway maintenance of the patient	163

11_ETSly_adult	Airway Maintenance_Endo Tracheal Stylet_adult	If a endo tracheal stylet(adult)is used for airway maintenance of the patient.	163
12_ETTH	Airway Maintenance_Endo Tracheal Tube Holder	If a endotracheal tube holder is used for holding endotracheal tube placed	163
13_OPA	Airway Maintenance_Oro Pharyngeal Airway	If an Oro pharyngeal airway is used for airway maintenance of the patient. If yes, also documenting the size of the airway	163
14_NPA	Airway Maintenance_Naso Pharyngeal Airway	If a Naso pharyngeal airway is used for airway maintenance of the patient. If yes, also documenting the size of the airway	163
15_LScopeBld	Airway Maintenance_Laryngoscope & Blade	If a laryngoscope and blade is used for airway maintenance	163
16_EGTA	Airway Maintenance_EGTA	If a Esophageal Gastric Tracheal Airway was used for airway maintenance of the patient	163
17_NGTu_10	Airway Maintenance NasoGastric Tube(11)	If a nasogastric tube is used for airway maintenance of the patient	163
17_NGTu_14	Airway Maintenance NasoGastric Tube(14)	If a nasogastric tube is used for airway maintenance of the patient	163
17_NGTu_16	Airway Maintenance NasoGastric Tube(16)	If a nasogastric tube is used for airway maintenance of the patient	163
17_NGTu_18	Airway Maintenance NasoGastric Tube(18)	If a nasogastric tube is used for airway maintenance of the patient	163
18_SucCath_10	Airway Maintenance Suction Catheter(10)	If a suction catheter is used for airway maintenance of the patient.	163
18_SucCath_14	Airway Maintenance Suction Catheter(14)	If a suction catheter is used for airway maintenance of the patient.	163
18_SucCath_18	Airway Maintenance Suction Catheter(18)	If a suction catheter is used for airway maintenance of the patient.	163
19_SucCathYnk	Airway Maintenance Suction Catheter Yank	If a suction catheter yank is used for airway maintenance	163
20_SucCatTubing	Airway Maintenance Suction Tubing	If a suction tubing is used for airway maintenance	163
21_SucCanist/Bgs	Airway Maintenance_Suction Cannister/Bags	suction cannister or bags used for airway maintenance	163
01_CstDecompKit	Other Specialized Services_Chest Decompression Kit	Chest Decompression Kits used for the patient	165
02_CPR	Other Specialized Services_Cardio-Pulmonary Resuscitation	cardiopulmonary resuscitation done as part of emergency treatment for the patient	165
03_CricThyrotomyKit	Other Specialized Services_Cricothyrotomy Kit	cricothyrotomy kits used as part of emergency treatment of the patient	165

04_Defib-Carversion	Other Specialized Services_Defibrillation-Cardioversion	Defibrillation or cardioversion done as part of emergency treatment of the patient	165
05_Extrica_Major	Other Specialized Services_Extrication_Major	extrications (major kind) necessary as part of emergency services to the patient	165
05_Extrica_Minor	Other Specialized Services_Extrication_Minor	extrications (minor kind) necessary as part of emergency services to the patient	165
06_R.S.I	Other Specialized Services_R.S.I.	Rapid Sequence Inductions done as part of emergency services to the patient If Cardiac interpretation was done for the patient	165
01_Card_Interpret	Cardiac Monitor_Cardiac Interpretation	Cardiac interpretation was done for the patient	167
02_DefibGel	Cardiac Monitor_Defibrillator Gel	Defibrillator Gel used for the patient	167
03_DefibPad	Cardiac Monitor_Defibrillator Pads	Defibrillator Pads used for the patient	167
04_EKGElc_Adu	Cardiac Monitor_EKG Electrodes_Adult	adult size EKG electrodes used for the patient	167
04_EKGElc_Pedi	Cardiac Monitor_EKG Electrodes_Paediatrics	defibrillator pacing pads used for the patient	167
05_PacingPads	Cardiac Monitor_PacingPads	Defibrillator pacing pads used for the patient	167
01_LacRing_1000	IV_Therapy_Lactate Ringers 1000 ml	Lactate Ringers (1000 ml) used for the patient as part of emergency treatment	169
02_NormSaline_1000	IV_Therapy_Normal Saline_1000 ml	Normal Saline (1000 ml) used for the patient as part of emergency treatment	169
03_D5W_500	IV_Therapy_Dextrose 5% by weight_500 ml	Dextrose 5% (500 ml) used for the patient as part of emergency treatment	169
04_IVDripSet_Type_01	Intravenous_Drip_Set_15gitt	15gitt Intravenous drip set used for treatment of patient	169
04_IVDripSet_Type_02	Intravenous_Drip_Set_60gitt	60gitt Intravenous drip set used for treatment of patient	169
05_BloodTubing	IV_Therapy_Blood_Y_Tubing	Number of Blood-Y-Tubing used for the patient as part of IV Therapy for emergency treatment	169
06_BuretolAdmSet	IV_Therapy_Buretol Administration Set	Number of the Buretol Administration set used for the patient as part of IV therapy for emergency treatment	169
07_DialAFlow	IV_Therapy_Dial-A-Flow	Number of Dial-A-Flow used as part of the IV Therapy for emergency treatment	169
08_ExtnSet	IV_Therapy_Extension set	Number of extension set used as part of IV Therapy for emergency treatment	169
09_IV_Cath_Type_1	IV Catheter_14ga	14ga IV Catheter used for treatment of patient	169
09_IV_Cath_Type_2	IV Catheter_16ga	16ga IV Catheter used for treatment of patient	169

09_IV_Cath_Type_3	IV Catheter_18ga	18ga IV Catheter used for treatment of patient	Liberty County EMS Charge sheet	169
09_IV_Cath_Type_4	IV Catheter_20ga	20ga IV Catheter used for treatment of patient	Liberty County EMS Charge sheet	169
09_IV_Cath_Type_5	IV Catheter_22ga	22ga IV Catheter used for treatment of patient	Liberty County EMS Charge sheet	169
09_IV_Cath_Type_6	IV Catheter_24ga	24ga IV Catheter used for treatment of patient	Liberty County EMS Charge sheet	169
10_IntrroseNedle	IV_Therapy_Intrroseous Needle	If intrroseous needle is used as part of IV Therapy for the patient	Liberty County EMS Charge sheet	169
11_Syring_1	Syringe_1cc	1cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
11_Syring_2	Syringe_3cc	3cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
11_Syring_3	Syringe_10cc	10cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
11_Syring_4	Syringe_20cc	20cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
11_Syring_5	Syringe_30cc	30cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
11_Syring_6	Syringe_60cc	60cc syringe used for IV therapy	Liberty County EMS Charge sheet	169
12_Venigu	IV_Therapy_Venigard	Venigard used for IV Treatment of emergency treatment of the patient	Liberty County EMS Charge sheet	169
13_AlcoPrep_BetaPrep	IV_Therapy_A Icohol Preparation or Betadine Preparation	alcohol preparations or betadine preparations used for the patient	Liberty County EMS Charge sheet	169
14_Hep-Locks	IV_Therapy Hep-Locks	IV Therapy...Hep Locks used	Liberty County EMS Charge sheet	169
15_SaFlu_10	IV_Therapy Saline Flush 10ml	saline flush (10ml) used for the patient	Liberty County EMS Charge sheet	169
16_18gaNedles	IV_Therapy_18ga Needles	Number of 18ga needles used for the treatment of the patient	Liberty County EMS Charge sheet	169
17_20gaNedles	IV_Therapy_20ga Needles	Number of 20ga needles used for the treatment of the patient	Liberty County EMS Charge sheet	169
01_Imm_BS_1	Immobilization_Board Splints_15 inches	15" board splint used for the treatment for the patient	Liberty County EMS Charge sheet	171
01_Imm_BS_2	Immobilization_Board Splints_30 inches	30" board splint used for the treatment for the patient	Liberty County EMS Charge sheet	171
01_Imm_BS_3	Immobilization_Board Splints_48 inches	48" board splint used for the treatment for the patient	Liberty County EMS Charge sheet	171
02_Immobi_C-Collar_pedi	Immobilization_C-collar_Type_pediatric	If C-collar used for the patient, type of C collar used	Liberty County EMS Charge sheet	171
02_Immobi_C-Collar_infant	Immobilization_C-collar_Type_infant	If C-collar used for the patient, type of C collar used	Liberty County EMS Charge sheet	171

02_Immobi_C-Collar_reg	Immobilization_C-collar_Type_regular	If C-collar used for the patient, type of C collar used	171
02_Immobi_C-Collar_shrt	Immobilization_C-collar_Type_short	If C-collar used for the patient, type of C collar used	171
02_Immobi_C-Collar_tall	Immobilization_C-collar_Type_tall	If C-collar used for the patient, type of C collar used	171
02_Immobi_C-Collar_NoN	Immobilization_C-collar_Type_No_Neck	If C-collar used for the patient, type of C collar used	171
03_Immobi_HeadImmobilizers	Immobilization_Head_Immobilizers	head immobilizers used for the patient's treatment	171
04_Immobi_Ked	Immobilization_Ked	Ked is used for immobilization	171
05_Immobi_LngBackBoard	Immobilization_Long Back Board	long back board is used for immobilization	171
06_Immobi_MastPants	Immobilization_Mast Pants	Mast Pants are used for immobilization of the patient	171
07_Immobi_MedDuctTape	Immobilization_Medical Duct Tape (2 inch)	Medical Duct Tape (2 inch) is used for immobilization of the patient	171
08_Immobi_ShrtBord	Immobilization_Short Board	Short Board is used for immobilization of the patient	171
09_Immobi_SpiderStraps_or_Webs	Immobilization_Spider Straps or Webs	Spider Straps or webs used for immobilization of the patient	171
10_Immobi_TractionSplt_Adult	Immobilization_Traction_Splint_Adult	traction splints of adult type used for immobilization of the patient	171
10_Immobi_TractionSplt_Pedi	Immobilization_Traction_Splint_pedi	traction splints of adult type used for immobilization of the patient	171
01_Bleeding_Contrl_Dresin_q_Abd_Pad	Bleeding_Control_Dressing_Abdominal Pad	If abdominal pad used for emergency treatment, number of such pads used for the patient	173
02_Bleeding_Contrl_Dresin_q_ClothTape_1	Bleeding_Control_Dressing_ClothTape_1inch	If 1inch cloth tape is used for control of bleeding or dressing as part of treatment, number of such cloth tapes used	173
02_Bleeding_Contrl_Dresin_q_ClothTape_2	Bleeding_Control_Dressing_ClothTape_2inch	If 2inch cloth tape is used for control of bleeding or dressing as part of treatment, number of such cloth tapes used	173
03_Bleeding_Contrl_Dresin_q_Kerlix	Bleeding_Control_Dressing_Kerlix	Number of kerlix is used for the treatment of the patient	173
04_Bleeding_Contrl_Dresin_q_Pads	Bleeding_Control_Dressing_Pads_5X9	If Dressing Pads of size 5 X 9 used for the patient, number of such pads used	173
05_Bleeding_Contrl_Dresin_q_PetroGauze	Bleeding_Control_Dressing_Petroleum_Gauze	If Petroleum Gauze used for bleeding control or dressing of the patient, number of such gauzes used	173

06_Bleeding_Control_Dresin_g_SterileBurnSheet	Bleeding_Control_Dressing_Sterile Burn Sheet	If sterile burn sheet is used for dressing or bleeding control of the patient, number of such sheets used	173
07_Bleeding_Control_Dresin_g_Steril4X4_singles	Bleeding_Control_Dressing_Sterile 4X4 singles	If Sterile 4X4 singles used for the dressing/bleeding control of the patient, number of such dressings used	173
08_Bleeding_Control_Dresin_g_Steril4X4_Tubs	Bleeding_Control_Dressing_Sterile 4X4_Tubs	If Sterile 4X4 tubs used for the dressing or bleeding control of the patient, number of such dressings used	173
09_Bleeding_Control_Dresin_g_Trau_Dresing_10X30	Bleeding_Control_Dressing_Trauma Dressing_10X30	If Trauma Dressing 10X30 used for dressing or bleeding control of the patient, number of such dressings used	173
10_Bleeding_Control_Dresin_g_TrigularBandage	Bleeding_Control_Dressing_TriangularBandage	If Triangular Dressing is used for dressing or bleeding control of the patient, number of such dressings used	173
01_Infectious_ctrl_BioHz_Bgs_small	Infectious_Control_Biohazard Bags_small	If Biohazard Bags used for infectious control during patient's treatment, number of such bags used	175
01_Infectious_ctrl_BioHz_Bgs_large	Infectious_Control_Biohazard Bags_large	If Large Biohazard Bags used for infectious control during patient's treatment, number of such bags used	175
02_Infectious_ctrl_Decon_of Unit_Minor	Infectious_Control_Decontamination of Unit_Minor	Number of minor decontaminations of unit done as part of infectious control	175
02_Infectious_ctrl_Decon_of Unit_Major	Infectious_Control_Decontamination of Unit_Major	Number of major decontaminations of unit done as part of infectious control	175
03_Infectious_ctrl_Gogs	Infectious_Control_Goggals	Number of goggles used for infectious control as part of treatment to the patient	175
04_Infectious_ctrl_IsolatinKit_Steath	Infectious control_Isolation Kit_with_Stethoscope	Number of Isolation kits with stethoscope used for the patient	175
05_Infectious_ctrl_Msk_Shield	Infectious control_Mask_and_Shield	Number of Masks with shield used for the patient for infectious control	175
06_Infectious_ctrl_RedTrashBags	Infectious control_Red Trash Bages	If red trash bags were used for infectious control as part of treatment of the patient, number of such bags used	175
01_Misc_Alco_Bott	Miscellaneous_Alcohol Bottle	If alcohol bottle used for treatment of the patient, number of such alcohol bottles used	177
02_Misc_AmmoniaCaps	Miscellaneous_Ammonia Caps	If ammonia caps used for the patient, number of such caps used	177
03_Misc_BandAids	Miscellaneous_BandAids	If bandaids used for the patient, number of such bandaids used	177

04_Misc_BiteStick	Miscellaneous_Bite Stick	If bite stick used for the treatment of the patient, number of such bite sticks used	177
05_Misc_BlbSymg	Miscellaneous_Bulb Syringe	If Bulb Syringes used for the treatment of the patient, number of such Bulb Syringes used	177
06_Misc_CldPak	Miscellaneous_ColdPack	Number of cold pack used for the treatment of the patient	177
07_Misc_DrnkWater	Miscellaneous_DrinkingWater	Number of drinking water service was provided to the patient	177
08_Misc_EmisisBasin	Miscellaneous_Emisis Basin	Number of emesis basin was provided as a service to the patient	177
09_Misc_HotPacks	Miscellaneous_Hot Packs	Number of Hot Packs provided as a part of treatment service to the patient	177
10_Misc_HydroPeroxide	Miscellaneous_Hydrogen Peroxide	Number of hydrogen peroxide used for the patient during the emergency treatment	177
11_Misc_OBKit	Miscellaneous_OB Kit	Number of OB kit (..??) was used for the treatment of the patient	177
12_Misc_SlvSwdder	Miscellaneous_Silver Swaddler	Number of silver swaddler used for the treatment of the patient	177
13_Misc_SteriGlv_Sm	Miscellaneous_Sterile Gloves_Small	Number of small size sterile gloves used for the treatment of the patient	177
13_Misc_SteriGlv_Med	Miscellaneous_Sterile Gloves_Medium	Number of medium size sterile gloves used for the treatment of the patient	177
13_Misc_SteriGlv_Lg	Miscellaneous_Sterile Gloves_Large	Number of large size sterile gloves used for the treatment of the patient	177
14_Misc_SteriWater_1000	Miscellaneous_Sterile Water_1000ml	If sterile water (1000 ML) used for the treatment of the patient, the number of such 1000 ml units used	177
15_Misc_SteriSaline_1000	Miscellaneous_Sterile Saline_1000ml	If sterile saline (1000 ML) used for the treatment of the patient, the number of such 1000 ml units used	177
16_Misc_VacutainerHolder	Miscellaneous_Vacutainer Holder	Number of vacutainer Holder used for the treatment of the patient	177
17_Misc_VacutainerNeedle_e	Miscellaneous_Vacutainer Needle_e	Number of vacutainer needle used for the treatment of the patient	177
18_Misc_WatSolLube	Miscellaneous_Water Soluble Lubricant	Number of water solution lubricant used for the treatment of the patient,	177
6_Pharm_Adult_Adenosine_6	Pharmaceuticals_Adult_Adenosine_6mg	If Adenosine (6MG) drug used for the patient, number of such supplies used	179

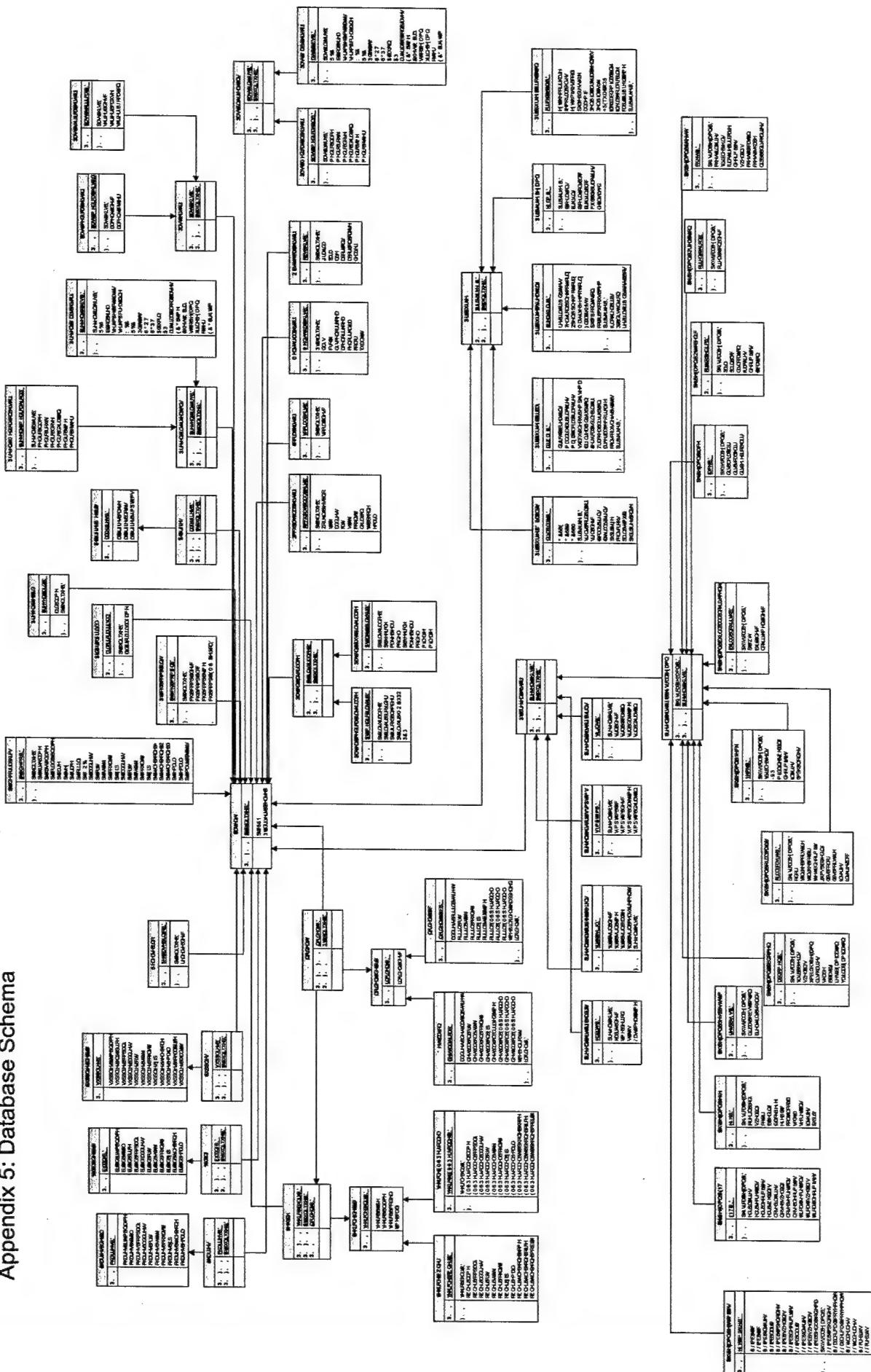
Pharm_Adult_Albuterol_83	Pharmaceuticals_Adult_Albuterol_.83mg	If Albuterol (.83MG) is used for the treatment of the patient, number of such supplies of Albuterol used	179
Pharm_Adult_Aspirin_81	Pharmaceuticals_Adult_Aspirin_.81mg	If Aspirin (.81MG) is used for the treatment of the patient, number of such supplies of Aspirin used	179
Pharm_Adult_Atropine_1	Pharmaceuticals_Adult_Atropine_.1mg	If Atropine (.1MG) is used for the treatment of the patient, number of such supplies of Atropine used	179
Pharm_Adult_Bretylum_500	Pharmaceuticals_Adult_Bretylum_.500mg	If Bretylum (.500MG) is used for the treatment of the patient, number of such supplies of Bretylum used	179
Pharm_Adult_CalcCarb	Pharmaceuticals_Adult_Calcium Carbonate_.465 Meq/10ml	If Calcium Carbonate (.465 Meq/10ML) is used for the treatment of the patient, number of such supplies of calcium carbonate used	179
Pharm_Adult_Dextrose	Pharmaceuticals_Adult_Dextrose_.50%	If Dextrose (50%) is used for the treatment of the patient, number of such units of dextrose used	179
Pharm_Adult_Diazepam	Pharmaceuticals_Adult_Diazepam_.10mg	If Diazepam (10MG) is used for the treatment of the patient, number of such supplies of diazepam used	179
Pharm_Adult_Diphenhydramine	Pharmaceuticals_Adult_Diphenhydramine_.50mg	If Diphenhydramine (.50MG) is used for the treatment of the patient, number of such supplies of diphenhydramine used	179
Pharm_Adult_Dopamine	Pharmaceuticals_Adult_Dopamine_.400	If Dopamine (.400MG) is used for the treatment of the patient, number of such supplies of dopamine used	179
Pharm_Adult_Epineph_1:1000	Pharmaceuticals_Adult_Epinephrine_.1:1000_1	If Epinephrine 1:1000 (1MG) is used for the treatment of the patient, number of such supplies of Epinephrine used.	179
Pharm_Adult_Epineph_1:10000	Pharmaceuticals_Adult_Epinephrine_.1:10000_1	If Epinephrine 1:10000 (1MG) is used for the treatment of the patient, number of such supplies of epinephrine used	179
Pharm_Adult_Epineph_1:100000	Pharmaceuticals_Adult_Epinephrine_.1:100000_1	If Epinephrine (1:1000, MDV, 30MG) is used for the treatment of the patient, number of such supplies of Epinephrine used	179
Pharm_Adult_Flumazenil	Pharmaceuticals_Adult_Flumazenil_.5mg	If Flumazenil (0.5MG) is used for the treatment of the patient, number of such supplies of Flumazenil used	179

Pharm_Adult_Furosemide	Pharmaceuticals_Adult_Furosemide_100	If Furosemide (100MG) is used for the treatment of the patient, number of such supplies of Furosemide used	179
Pharm_Adult_InstGlu	Pharmaceuticals_Adult_Instant Glucose_30	If Instant Glucose (30MG) is used for the treatment of the patient, number of such supplies of Instant Glucose used	179
Pharm_Adult_Lidocaine	Pharmaceuticals_Adult_Lidocaine_100	If Lidocaine (100MG) is used for the treatment of the patient, number of such supplies of Lidocaine used	179
Pharm_Adult_Lidocaine_Drip	Pharmaceuticals_Adult_Lidocaine Drip	If Lidocaine Drip (2GM/500ML) is used for the treatment of the patient, number of such supplies of Lidocaine drip used	179
Pharm_Adult_MagSulf	Pharmaceuticals_Adult_Magnesium Sulfate	If Magnesium Sulfate (5GM/10ML) is used for the treatment of the patient, number of such supplies of Magnesium Sulfate used	179
Pharm_Adult_Mannitol	Pharmaceuticals_Adult_Mannitol	If Mannitol (100GM/500ML) is used for the treatment of the patient, number of such supplies of Mannitol used	179
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Pharm_Adult_Morphine_10	Pharmaceuticals_Adult_Morphine_10MG	If Morphine 10MG is used for the treatment of the patient, number of such supplies of Morphine used	179
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Pharm_Adult_Promethazine	Pharmaceuticals_Adult_Promethazine_25MG	If Promethazine 25MG is used for the treatment of the patient, number of such supplies of Promethazine used	179

Pharm_Adult_Sodium_Bicarb_8.4	Pharmaceuticals_Adult_Sodium Bicarbonate_8.4 MG	If Sodium Bicarbonate 8.4Meq is used for the treatment of the patient, number of such supplies of Sodium Bicarbonate used	179
Pharm_Adult_Solumedrol_125	Pharmaceuticals_Adult_Solumedrol_125 MG	If Solumedrol 125 MG is used for the treatment of the patient, number of such supplies of Solumedrol used	179
Pharm_Adult_Solumedrol_1	Pharmaceuticals_Adult_Solumedrol_1 GM	If Solumedrol 1 GM is used for the treatment of the patient, number of such supplies of Solumedrol 125MG used	179
Pharm_Adult_Succinicholine_200	Pharmaceuticals_Adult_Succinicholine_200 MG	If Succinicholine 200MG is used for the treatment of the patient, number of such supplies of Succinicholine used	179
Pharm_Adult_Terbutaline_1	Pharmaceuticals_Adult_Terbutaline_1 MG	If Terbutaline 1MG is used for the treatment of the patient, number of such supplies of Terbutaline used	179
Pharm_Adult_Thiamine_100	Pharmaceuticals_Adult_Thiamine_100 MG	If Thiamine 100MG is used for the treatment of the patient, number of such supplies of Thiamine used	179
Pharm_Adult_Verapamil_5	Pharmaceuticals_Adult_Verapamil_5 MG	If Verapamil 5MG is used for the treatment of the patient, number of such supplies of Verapamil used	179
Pharm_Adult_Versed_2	Pharmaceuticals_Adult_Versed_2MG	If Versed 2MG is used for the treatment of the patient, number of such supplies of Versed used	179
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Pharm_Pedi_Atropine	Pharm_Pedi_Atropine_0.5MG	Atropine 0.5MG used for the treatment of the patient, number of such supplies of Atropine used	181
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Appendix 5: Database Schema



# **LIBERTY COUNTY EMERGENCY MEDICAL SERVICE**

**JANUARY 2001**

## **PROTOCOLS FOR THERAPY**

- **Medical Protocols**
- **Pediatric Protocols**
- **Trauma Protocols**
- **Appendix**

Mike R. Templeton  
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Email your comments

# LIBERTY COUNTY EMERGENCY MEDICAL SERVICE

## MEDICAL PROTOCOLS

- Acute Abdomen
- Anaphylactic Reactions
- Altered Mental Status
- Childbirth
- Obstetrical Complications
- Magnesium Sulfate Toxicity
- Dead on Scene
- Dehydration
- Hypothermia
- Heat Exhaustion / Heat Stroke
- Hypertension
- Hyperventilation
- Hypotension
- Medical Unspecific
- Overdose / Poisoning
- Respiratory Distress non Cardiac
- Seizures
- Stroke (CVA)
- Chest Pain
- Respiratory Distress Cardiac Related
- Cardiogenic Shock
- Asystole
- Bradycardia / A V Dissociation
- Pulseless Electric Activity (PEA)
- Tachycardia -- Stable
- Ventricular Ectopy / PVC's
- Ventricular Fibrillation
- Ventricular Tachycardia
- Asystole -- Tree
- Bradycardia / A V Dissociation -- Tree
- Pulseless Electrical Activity -- Tree
- Tachycardia -- Tree
- Ventricular Ectopy / PVC's -- Tree
- Ventricular Fibrillation -- Tree
- Ventricular Tachycardia -- Tree

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# **LIBERTY COUNTY**

## **EMERGENCY MEDICAL SERVICE**

### **PEDIATRICS PROTOCOLS**

- Neonate
- Guidelines for Pediatrics
- Pediatric Arrest
- Pediatric Medical Unspecific
- Pediatric Trauma

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# NEONATE

## BASIC INTERVENTION

- Warm and prepare isolate prior to arrival.
  - a. Hypothermia can be lethal
  - b. Maintain a thermo neutral environment
- Perform primary and secondary surveys.
- Establish oxygen therapy as required by patient's condition.
  - a. Ensure proper positioning for airway control
  - b. Maintain patent airway
  - c. Use proper device

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Intubate, if needed
2. Establish IV of NS on buritol drip
  - a. At 60-80 ml/Kg/day for first day of life
  - b. Requirements usually increase approximately 10 ml/day on subsequent days
  - c. Avoid fluid overload
3. Check Dextro-stick.

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.
- Special situations in Neonatal Transport:
  - a. Surfactant deficiencies and/or pneumonia
    1. Clear airway / maintain patency
    2. Correct body positioning
    3. Oxygenation
  - b. Pulmonary air leaks
    1. Mild needle thoracentesis
    2. Clear airway / maintain patency
    3. Correct body positioning
    4. Oxygenation
  - c. Cardiac
    1. Different between cardiac disease vs respiratory disease

- 2. Clear airway / maintain patency**
- 3. Correct body positioning**
- 4. Oxygenation**
- 5. Treat symptoms of failing myocardium**
- 6. Arrhythmia protocols**
- 7. Consider hypoventilation as cause**

**d. Seizures**

- 1. Establish and maintain airway as needed**
- 2. Oxygenation**
- 3. Consider Valium**

- Always consider hypoxia before anything else**

## **CONTACT MEDICAL CONTROL**

# GUIDELINES FOR PEDIATRICS

## GUIDELINES FOR PEDIATRICS

AGE	PULSE	RESPIRATIONS	BP
Neonate	100 to 160	40 to 60	40 to 90 systolic 20 to 60 diastolic
6 months	>100 to 160	30 to 60	80 to 106 systolic 52 to 66 diastolic
2 years	>80 to 110	24 to 40	96 to 106 systolic 52 to 66 diastolic
7 years	>65 to 110	18 to 30	96 to 112 systolic 56 to 70 diastolic
15 years	>50 to 90	12 to 16	112 to 128 systolic 66 to 80 diastolic

Device	Infant	8 to 11 kg	12 to 14 kg	14 to 17 kg	18 to 23 kg	24 to 30 kg
O2 Mask	Newborn	Pediatric	Pediatric	Pediatric	Pediatric	Pediatric
BVM	Infant	Child	Child	Child	Child	Child
OP Airway	Infant	Child	Child	Child	Small Adult	Small Adult
Blade	0 to 1	1	2	2	2	2 to 3
ET Tube	>2.5 to 3.5	4.0	4.5	5.0	5.5	6.0
IV Cath	>22 to 24	20 to 24	18 to 22	18 to 22	18 to 20	18 to 20

## PEDIATRIC ARREST

Pediatric cardiac and trauma arrest should be treated with Adult Algorithms using the following drug and defibrillation dosages.

### Pediatric Code Drugs

- Epinephrine 1: 10,000
  - a. Supplied 0.1 mg / cc
  - b. Dose 0.01 mg / kg
- Epinephrine 1:1000
  - a. Supplied 1 mg / cc
  - b. Dose 0.1 mg / kg
- Sodium Bicarbonate
  - a. Supplied 1 mEq / cc
  - b. Dosage 1 cc / kg
- Atropine
  - a. Supplied 0.1 mg / cc
  - b. Dosage 0.02 mg / kg
- Lidocaine
  - a. Supplied 20 mg / cc
  - b. Dosage 1 mg/kg
- Narcan
  - a. Supplied 0.2 mg / cc
  - b. Dosage 0.02 mg / kg minimum
- Valium
  - a. Supplied 5 mg / cc
  - b. Dosage 0.1 mg / kg
- Dextrose
  - a. Supplied 25 g / 50 cc
  - b. Dosage 1 cc / kg
- Defibrillation
  - a. 2-4 joules per kg of weight

### Standard Weight Estimates

1 year old	3 year old	5 year old	8 year old	10 year old
10 kgs	15 kgs	20 kgs	25 kgs	30 kgs

# PEDIATRIC MEDICAL - UNSPECIFIC

## BASIC INTERVENTION

- Perform primary and secondary surveys.
- Obtain present and past medical history
- Obtain temperature, rectally if possible.
- Obtain vital signs.
- Administer oxygen therapy as dictated by patients clinical presentation

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Intubate, if needed
2. If patient shows signs of hypotension or hypoperfusion, establish IV of NS with buritrol, titrated to maintain normotension

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.

## CONTACT MEDICAL CONTROL

Standard IV Rates for Typical, Non Hypovolemic, Pediatric Patient

Age	Weight	Rate
1	10 kgs	40 cc/hr
3	15 kgs	50 cc/hr
5	20 kgs	60 cc/hr
8	25 kgs	70 cc/hr
10	30 kgs	75 cc/hr

## **PEDIATRIC TRAUMA**

### **BASIC INTERVENTION**

- Perform primary and secondary assessment
- Protect the cervical spine, immobilize if needed.
- Stop all life threatening bleeding
- Administer high flow oxygen, assist respirations with BVM if needed.
- Obtain vital signs.
- Begin transport if patient is considered "urgent" or "critical"

### **ADVANCED LIFE SUPPORT**

#### **INTERMEDIATE INTERVENTION**

1. Intubate, if needed
2. Establish IV of LR, titrate to maintain a normal blood pressure for the patient's age and size. Establish a second IV of LR if patient's clinical presentation or mechanism of injury justifies. Use a buritrol. May use Saline Lock.

#### **PARAMEDIC INTERVENTION**

- Apply cardiac monitor and obtain strip.

#### **CONTACT MEDICAL CONTROL**

# **LIBERTY COUNTY**

## **EMERGENCY MEDICAL SERVICE**

### **TRAUMA PROTOCOLS**

- Amputations
- Burns
- Head Injury Isolated
- Maxillofacial Injury
- Near Drowning
- Snake Bite
- Trauma

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# AMPUTATIONS

## BASIC INTERVENTION

- Perform a primary and secondary survey.
- Control hemorrhage with direct pressure.
- Obtain history of present illness and past medical history
  - a. Time of amputation
  - b. Mechanism of amputation
  - c. Bystander care of severed part
  - d. Medication usage
- Treat other urgent injuries.
- Administer oxygen as dictated by clinical presentations.
- Treat for hemorrhagic shock if necessary.
- Cover amputated part with sterile gauze. Moisten with normal saline. Next, cover with dry dressing, then splint, then elevate.
- Place severed part in sterile gauze, Moisten with normal saline place in a water tight container, and pack container in ice but do not freeze.
- If partial amputated, dress with moist gauze , splint in alignment with extremities to ensure optimum blood flow. Avoid torsion when handling amputated part.
- If amputated extremity and profuse bleeding cannot be controlled by direct pressure, elevation, pressure dressing, or pressure point contact medical control for possible application of a tourniquet.

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Establish Intravenous Line of LR and titrate to systolic blood pressure of 100 mm Hg. If amputation is to an extremity and time permits, start a second IV of LR.

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.

### CONTACT MEDICAL CONTROL

# BURNS

## BASIC INTERVENTION

- Perform a primary and secondary survey.
- Obtain history of present illness and past medical history
  - a. Cause of burn (chemical, thermal, electrical, etc.)
  - b. Length of exposure
  - c. Length of time in enclosed compartment
  - d. Type of material burning
  - e. Past history of smoking, CV problems, COPD
  - f. Bystander treatment
- Administer high flow oxygen 100% humidified
- Suction as needed
- C Spine immobilization if not cleared.
- Cover affected areas with dry sterile dressings/sheet. If chemical exposure begin decontamination with copious amounts of water or saline.
- Treat associated fractures, lacerations, or other injuries.

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Intubate early if any respiratory distress or if needed
2. Establish Intravenous Line of LR at 100 cc per hour or titrate to systolic blood pressure of 100 mm Hg.

Note: The goal of fluid resuscitation is to maintain vital organ function while avoiding complications of inadequate or excessive therapy.

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.
- Administer Morphine 2 to 6 mg IV for severe pain, if available.  
(Use only if no suspicion of respiratory burns or associated injuries)

### CONTACT MEDICAL CONTROL

## **HEAD INJURY - ISOLATED**

### **BASIC INTERVENTION**

- Perform primary and secondary survey
- Oxygen therapy as dictated by patient's condition
- Cervical spine immobilization unless cleared.
- Monitor vital signs
- Transport in supine or 30 degree elevation of the head, if not contraindicated.

### **ADVANCED LIFE SUPPORT**

#### **INTERMEDIATE INTERVENTION**

1. Intubated if needed.
2. IV of LR TKO

#### **PARAMEDIC INTERVENTION**

- Apply cardiac monitor and obtain strip.
- Treat hypotension with hypotension protocol
- If patient presents with Glasgow Coma scale of < 8 and with lateralizing signs (i.e. weakness to one side or unequal pupils) administer Mannitol 20% 1-2 gm/kg, filtered IV, over 30 minutes.

Note: To administer mannitol 20% you must use a Blood Y Tubing for the in line filter.

- Consider mannitol, as above, based on referral center recommendations.

### **CONTACT MEDICAL CONTROL**

# MAXILLOFACIAL INJURY

## BASIC INTERVENTION

- Perform a primary and secondary survey.
- Oxygen therapy as dictated by patient's condition
- Vital signs
- Spinal immobilization if not cleared.
- For Orbital or Zygomatic fractures apply loose binocular bandaging
- For Nasal Fractures treat epistaxis by direct pressure or nasal packing.
- Transport in semi high Fowler's or higher if not contraindicated.

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Intubate if needed, must be direct visualization only
2. IV of LR TKO

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.

## CONTACT MEDICAL CONTROL

## NEAR DROWNING

### BASIC INTERVENTION

- Protect the Cervical Spine if a suspected diving injury or possibility of impact with an object.
- Remove victim from the water
- Perform primary and secondary survey.
- Obtain history of present illness and past medical history.
- Administer high flow oxygen
- Obtain and record vital signs

### ADVANCED LIFE SUPPORT

#### INTERMEDIATE INTERVENTION

1. Intubated if needed.
2. Establish IV of LR TKO.

#### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.
- Treat dysrhythmias as per specific protocol.

#### CONTACT MEDICAL CONTROL

## **SNAKE BITE**

### **BASIC INTERVENTION**

- Perform primary and secondary survey
- Obtain information on snake type or description if possible. (If possible bring DEAD snake to the ED for positive identification.)
- Obtain vital signs.
- Administer oxygen with flow and device being dictated by patients clinical presentation.
- IF CORAL SNAKE: wash wound site with copious amounts of water.
- Immobilize affected limb with splint at the level of the heart.
- Keep patient supine.
- Do not apply ice, cold pack, tourniquet or restriction band.
- Call poison control 1 800 764 7661 if bite orenvenomation.

### **ADVANCED LIFE SUPPORT**

#### **INTERMEDIATE INTERVENTION**

1. Establish IV of LR, titrate to maintain a systolic BP of 100 mm Hg.

#### **PARAMEDIC INTERVENTION**

- Apply cardiac monitor and obtain strip.

#### **CONTACT MEDICAL CONTROL**

# TRAUMA

## BASIC INTERVENTION

- Perform primary and secondary survey
- Obtain history of present illness and past medical history.
  - a. Mechanism of injury
  - b. Vehicle speed
  - c. Seat belt use
  - d. Integrity of vehicle compartment
  - e. Ballistics information
- Maintain airway and immobilize the cervical spine.
- Treat life threatening injuries.
- Monitor the vital signs every 5-10 minutes, more frequently if patient unstable.
- Administer oxygen as indicated by patient condition.
- Treat if:
  - a. Aystolic blood pressure less than 100 mm Hg and signs and symptoms of shock exist.
  - b. Suspected blunt/penetrating chest or abdominal trauma associated with signs and symptoms of shock.
  - c. There are suspected fractures of the femur or pelvis.

## ADVANCED LIFE SUPPORT

### INTERMEDIATE INTERVENTION

1. Intubate where appropriate.
2. Establish two IV's of LR, with maxi-drip tubing and large bore catheter.
3. Establish second IV en route to hospital.

### PARAMEDIC INTERVENTION

- Apply cardiac monitor and obtain strip.
- Consider for patients with isolated long bone fractures, otherwise hemodynamically stable, with no possibility of other occult injuries, morphine sulfate 2 to 6 mg IV, titrated for effect.
- If patient is combative and compromising spinal control, consider administering Diazepam 2-10 mg slow IVP or Versed 2 to 4 mg

Appendix 6

**(RULE OUT HYPOXIA OR SHOCK AS CAUSE OF AGITATION,  
MONITOR RESPIRATIONS.)**

- IF patient presents with definite paralysis from spinal injury or spinal shock or signs, consider Solumedrol 30 mg/kg IV drip over 1 hr.

**CONTACT MEDICAL CONTROL**

# LIBERTY COUNTY EMERGENCY MEDICAL SERVICE

## APPENDIX

- Appendix A - Trauma Score
- Appendix B - Oxygen
- Appendix C - Drugs
- Appendix D - IV Access Saline Locks Drugs IV
- Appendix E - Over the Counter Medications
- Appendix F - Advanced Paramedic Skills
- Appendix G - Maximum on the Scene Attempts
- Appendix H - Do Not Resuscitate Orders
- Appendix I - Load and Go Situations
- Appendix J - Out of Radio Contact / Beyond Medic
- Appendix K - Physician on Scene

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# APPENDIX A - Trauma Score

## BASIC INTERVENTION

The trauma score developed by Dr. Champion consists of the Glasgow Coma Scale plus four other variables. Total scores can range from 1-16. The lower the score, the greater the severity of the injury.

### A. Glasgow Coma Scale

The Glasgow coma Scale quantifies the level of consciousness by measuring three aspect of neurologic function. The scale was developed to monitor status over time.

#### 1. Eye opening

a. spontaneous	4
b. to voice	3
c. to pain	2
d. none	1

#### 2. Verbal response

a. oriented	5
b. confused	4
c. inappropriate words	3
d. incomprehensible sounds	2
e. none or intubated	1

#### 3. Motor response

a. obeys command	6
b. localizes pain	5
c. withdraws from pain	4
d. flexion response	3
e. extension response	2
f. none	1

### B. Trauma Score Variables

#### 1. Respiratory Rate

a. 10-24 per min	4
b. 24-35 per min	3
c. > 35 per min	2
d. 1-9 per min	1
e. none	0

#### 2. Respiratory Expansion

## Appendix 6

a. normal	1
b. refractive	0
3. Systolic blood pressure	

a. >90	4
b. 70-89	3
c. 50-79	2
d. 0-49	1
a. none	0

4. Capillary refill

a. normal	2
b. delayed	1
c. none	0

### C. Total Trauma Score (part a + part b)

#### Conversion for Glasgow coma score

Glasgow Coma Score	Trauma score equivalent
14-15	5
11-13	4
8-12	3
5-7	2
3-4	1

Add Glasgow conversion to trauma score from part b to get total trauma score.

#### Probability of Survival (Ps) for Trauma Score Values

TS	PS
1-4	<15%
8-12	50-80%
5-7	20-40%
13-16	>90%

## APPENDIX B : Oxygen

### General:

The use of oxygen is indicated by your assessment and by the specific disorder discovered. High flow rates are required in patients with evidence of respiratory burns, hypovolemia, complicated deliveries, and / or signs of hypoxia or shock.

The use of high flow oxygen in patients with known chronic CO<sub>2</sub> retention, a small subgroup of COPD patients, may cause respiratory arrest. Note that high flow oxygen should not be withheld from these patients when assessment indicates hypoxia. Carefully monitor respiratory rate and effort and be prepared to assist or control ventilation as required.

If Available Pulse Oximetry readings should be recorded before and after administration of oxygen.

### Humidified Oxygen:

The administration of oxygen is necessary and therapeutic in transport situations. Adding humidity to the flow of oxygen should not delay the initial use of oxygen in indicated clinical situations.

Because the administration of oxygen dries the mucus membranes, certain situations require the use of humidified oxygen.

Such situations include administration of oxygen for greater than four hours and childhood croup.

## APPENDIX C : Drugs

Drug	Dosage(s)	Route	Speed	Max Dose	Frequency
Adenosine	6 mg	IV	Fast	18 mg	3 minutes
Atropine	0.5 to 1 mg	IV, ET	Fast	4 mg	5 minutes
ASA (Baby)	2 tabs	PO (chewed)	N/A	2 tabs	once only
Benadryl	25 to 50 mg	IV, IM	Slow	50 mg	once only
Amiodarone	150 mg	IV	Slow	150 mg	10 minutes
Calcium	1 gram	IV	Slow	1 gram	once only
Dextrose	25 grams	IV	Slow	50 grams	10 minutes
Calcium	1 gram	IV	Slow	1 gram	once only
Calcium	1 gram	IV	Slow	1 gram	once only
Epinephrine 1:10,000	0.5 to 1 mg	IV, ET	Fast	None	3 to 5 minutes
Epinephrine 1:1000	0.2 to 0.3 mg or 1 mg/kg	IV, SQ	Fast	0.6 mg SQ None IV	3 to 5 minutes
Lasix	40 mg	IV	Slow	40 mg	once only
Lidocaine	1st dose 1 to 1.5 mg/kg, 2nd dose 0.5 mg/kg	IV	Fast arrest Slow PVC's	3 mg/kg	5 minutes
Solumedrol	2 mg/kg asthma COPD 30 mg/kg spinal	IV,IM,IVPB	Slow asthma, over 30 minutes spinal	125 mg asthma, None spinal	once only
Morphine	2 to 6 mg	IV	Slow	15 mg	5 to 30 minutes
Narcan	1 to 2 mg	IV, ET	Slow	4 mg	5 minutes
Nitroglycerin	0.4 mg (1/150)	SL	N/A	1.2 mg	5 minutes
Procardia	10 mg	SL	N/A	10 mg	once only
Sodium Bicarbonate	1 meq/kg	IV	Fast Arrest, Slow other	None	5 minutes

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Succynl-choline	1 mg/kg	IV	Fast	None	once only
Thiamine	100 mg	IV	Slow	100 mg	once only
Valium	2 to 5 mg	IV	Slow	10 mg	10 minutes
Verapamil	5 to 10 mg	IV	Slow	15 mg	10 minutes
Terbutaline	0.01 mg/kg to max .25 mg	SQ	Slow	15 mg	10 minutes
Procainamide	17 mg/kg	IV	30 mg/min	17 mg/kg	once only
Atrovent	Unit dose	Nebulized		None	20 minutes

Drug	Mix Ratio	Infuse
Dopamine	200 mg in 250 cc	2 to 20 ug/kg/min
Lidocaine	2 grams in 500 cc	2 to 4 mg / min 30 to 60 cc / hr
Magnesium Sulfate	10 grams in 500 cc	Per Physicians orders
Procainamide	2 grams in 500 cc	1 to 4 mg / min 15 to 60 cc / hr

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# APPENDIX D : IV Access-Saline Locks-Drugs

## General Standards

**Protection:**

Before initiation of any IV, Employees are required to wear protective gloves, mask, and goggles for the possibility of blood splatter.

**Catheter Size:**

The catheter size implied is 18 ga if possible. Where stated largest bore, evaluate the success of a 14 to 16 ga.

**Access:**

During cardiac arrest, a peripheral vein, antecubital should be the first choice. Drugs require 1 2 minutes to reach the central circulation when given by a peripheral vein.

**IV Medication:**

Intravenous medications should be administered rapidly by bolus injection and followed by a 20 ml bolus of IV fluid. this can be achieved by: WIDE OPEN IV and squeeze bag for a 20 cc, and ELEVATION OF THE EXTREMITY.

Suggested methods of elevation:

1. Place pillow under the arm used for IV access
2. Use Kerlex, tape, triangle bandage to secure arm to ceiling rail, or IV bag hanger.

## APPENDIX E : Over The Counter Medications

The providers of first aid recognize that certain patrons present with minor complications and ask for over the counter medications. The following medications will be available to those patrons as a courtesy, and as part of our service as providers in Medical and/or Rehab sectors at extended scenes and /or stand by's.

1. Acetaminophen
2. Ibuprofen
3. Sudafed
4. Midol
5. Rolaids
6. Cepacol
7. Peptobismol
8. Imodium AD

## APPENDIX F : Paramedic Skills

The following section contain skills that are only to be used by paramedics.

1. Nasotracheal Intubation
2. Surgical Cricothyroidotomy
3. Needle Chest Decompression
4. External Jugular Vein Cannulation
5. Intraosseous Needle placement
6. Rapid Sequence Intubation
7. Esophageal Obturator Airway
8. Nasogastric Tube

## APPENDIX G : Maximum on scene attempts

In order to provide the best possible care and in the interest of the patient, the following limits on intubation and IV attempts have been established:

**1. IV Access:**

- a. Non-critical and urgent patients: There shall be no more than 2 attempts made per medic on the scene and no more than 3 total attempts made on scene. If an IV cannot be established within the limits the patient is to be transported to the hospital and any other attempts shall be made en route to the receiving facility.
- b. Critical and load n go patients: There shall be no more than 2 attempts made on scene, (unless awaiting for extrication or helicopter transport.) If an IV cannot be established within this limit the patient is to be transported to the hospital with all other attempts done in route to the receiving facility.

**2. Intraosseous infusions:** There shall be no more than 2 IO attempts made on the scene. If an IO cannot be established within this limit the patient is to be transported to the hospital and any other attempts shall be made en route to receiving facility **And WITH ON LINE MEDICAL CONTROL DIRECTION.**

**3. Intubation:**

- a. Critical patients: There shall be no more than 2 attempts made per medic on the scene and no more than 4 attempts total made on scene. If the patient cannot be intubated within the limits the patient is to be transported to the hospital and any other attempts at intubation are to be done en route to the receiving facility.
- b. Load n Go patients: There shall be no more than 2 intubation attempts made on the scene. If the patient cannot be intubated within this limit the patient is to be transported to the hospital and or any other attempts shall be made en route to the receiving facility.

## Do Not Resuscitate Orders

- 1. Emergency Calls (911):** The patient or family member in calling the emergency services triggers a presumption that resuscitative measures should be instituted. The vast majority of situations would require immediate institution of all measures. However, some situations arise in which a particular patient's desires are in opposition to the immediate intervention of resuscitative techniques. The State of Texas recognizes the right of a patient to outline their own desires in an Out Of Hospital DO NOT RESUSCITATE ORDER. (See chapter 674 of the Health & Safety Code) Therefore in an emergency situation immediate resuscitation will be performed unless the EMT visualizes either:
  - a. An arm band on the patient signifying the Out of Hospital Do Not Resuscitate Order has been signed or,
  - b. A written DNR order with the patient.
- 2. Transfer Situations (Non 911):** Immediate and full implementation of resuscitative techniques is the standard except in two situations:
  - a. Hospice patient: Most hospice patients have made arrangements for the terminal event prior to the actual event. The wishes of the patient should be honored even if verbally communicated from a hospice representative.
  - b. Do Not Resuscitate orders either from a facility or an advanced directive should be honored if presented in a written form. Verbal communication of such orders may be respected if it is reasonable. (e.g. nurse states that they are on the chart, a family member states they exist but cannot be found in an emergency.) Evidence of foul play would void any such reasonable assumption.

## APPENDIX I : Load and Go Situations

1. Patients who shall be considered for immediate emergency transport after establishing an airway and BLS measures have been initiated are, but not limited to:
  - a. Significant head or spinal injuries with evidence of decreasing neurological status.
  - b. Blunt or penetrating trauma of the chest and / or abdomen with signs of decreasing tissue perfusion.
  - c. Pediatric arrest, trauma and cardiac ( less than 2 years old).
  - d. Obstetrical patients with evidence of prolapsed cord, breech delivery, or presentations.
  - e. Trauma arrest.

This is to imply that if a patient is not stabilized on scene, then initiate ALS protocols in route to the closest appropriate definitive care facility. If a patient is considered a Load and Go patient, an immediate transport can not be made due to unusual circumstances (entrapment, on a roof, etc.) than the reasons for delay shall be documented on either the Basic Management Form or an incident report.

## APPENDIX J : Out of Radio Contact / Beyond Medical Control

1. **Objective:** To provide guidelines for the provision of necessary emergency medical care by Liberty County EMS personnel when contact with a physician is not feasible and this care is not covered in standing orders.
2. **Indications:**
  - a. The patient needs further ALS care beyond standing orders.
  - b. The treatment requires deviation from standing orders. Radio or phone contact with physician is not feasible. In extreme cases where the time required to establish contact would be so great and / or necessitate leaving the patient, that it would be detrimental to the patients survival.
3. **Procedure:** EMS treatment should be consistent with current established treatment guidelines and when the course of treatment is not specifically addressed by protocol, the In charge medic's judgment should dictate the course of treatment according to his or her training and experience.
4. **Precautions:** All treatment rendered by Liberty County EMS personnel is under review and liability of the Medical Director, and full and complete documentation of treatment given is required.

**Note:**

After such cases, the paramedic shall completely document in narrative form all reasons requiring intervention and all actions taken and provide to:

1. Clinical Director
2. Medical Director
3. Duty Supervisor

**The word "CONSIDER"**

When "consider" is used in these protocols it is an option of the paramedic rather than an order to perform. The paramedics' judgment should dictate this course of treatment according to his or her training and experience. After such cases, the paramedic in charge shall completely document in narrative form to Medical Director.

## APPENDIX K : Physician on Scene

1. Medics shall treat all physicians on scene with respect and shall explain any questions that may arise.
2. A physician on scene who is caring for a patient prior to arrival of the EMT may retain medical responsibility if he so desires, provided that he will accept full legal and medical responsibilities and, therefore, accompany the patient to the hospital in the EMS vehicle. Only then will orders given by physicians on scene be followed.
3. A physician on scene arriving after care has been initiated by the EMT may offer his services to the Medical Control Physician who shall have the sole authority to accept or deny the request. The Medical Control Physician ambulance crew / physician on scene shall work as a team if such permission is granted. The Medical Control Physician may refuse to honor orders he feels medically inappropriate (according to established protocols) and the ambulance crew shall ultimately be responsible to the Medical Control Physician. Responsibility for transport shall be mutually determined by the physicians.
4. The final authority for medical control of advanced life support procedures rests with the Medical Control Physician. He shall have personal radio communications with the physician on scene.
5. In the event an on scene Physician assumes legitimate medical control, but then refuses to accompany the patient to the hospital, the paramedics will revert to usual protocols and medical control.
6. An order from an on-scene physician to take a patient to a hospital which is not the closest, most appropriate, or who has not been stabilized according to protocol, will not be honored unless the physician accompanies the patient.

## APPENDIX 7

### Attributes of Jabber as Notifier

#### **Introduction**

The Jabber notification system has the following key features:

- XML foundation
- distributed network
- open protocol and codebase
- modular, extensible architecture

The paragraphs below provide a high-level overview of the architecture of Jabber.

#### **Foundations**

Jabber communications are made possible by a distributed network of servers that use a common protocol, to which specialized clients connect to receive messages as well as to send messages to users of the same server or any other Jabber server that is connected to the Internet.

Jabber delivers messages in close to real time because the Jabber server (and, by extension, other Jabber users) knows when a particular user is online. This knowledge of availability is called presence and is the key enabler of instant messaging. Jabber combines these standard IM characteristics with two additional features that make Jabber unique. The first is an **open protocol** which enables interoperability among messaging systems. The second is a **strong foundation in XML**, which makes structured, intelligent messaging possible not only between human users but also between software applications.

#### **Client/Server**

Jabber uses client-server architecture, not a client-to-client architecture as some instant messaging systems do. All Jabber messages and data from one client to another must go through the server. Any client is free to negotiate a direct connection to another client, but those connections are for application-specific usage only. There are even specific instances where this is encouraged, such as file transfers, but those instances are negotiated first within the context of a client-server framework.

#### **Distributed Network**

Each user has their local server which receives information for them, and the servers transfer messages and presence information among themselves. There can exist any number of Jabber servers which accept connections from clients as well as communicate to other Jabber servers. Each server functions independently of the others, and maintains its own user list. Any Jabber server can talk to any other Jabber server that is accessible via the Internet. A particular user is associated with a specific server (either through registration with a service provider or administrative setup within an enterprise), and Jabber addresses are of the same form as email addresses, e.g., [stpeter@jabber.org](mailto:stpeter@jabber.org).

## Modular Server

The Jabber server plays two primary roles:

- Listening for client connections and communicating directly with client applications.
- Communicating with other Jabber servers.

The Jabber open-source server is designed to be modular, with specific code packages that handle functionality such as user authentication, data storage (offline messages, rosters, user info), and the like. In addition, the server can be extended with additional services, such as integrated security, allowing special connections for server-side components or alternative clients, and gateways to other messaging systems.

As an example of such modularity, the exchange of messages and presence information between Jabber and any given non-Jabber messaging system is made possible by means of a separate "transport" that translate Jabber XML into the foreign protocol. Such transports are not part of the core server. Instead, they are server-side programs that can be added rather easily to the core server to provide enhanced functionality to the end user.

## Simple Clients

One of the design criteria for the Jabber system was that it must be capable of supporting simple clients (e.g., even something as simple as a telnet connection). Indeed, the Jabber architecture imposes very few restrictions on clients. The only features which a client must support are:

- Communicate to the Jabber server via TCP sockets.
- Parse and interpret well-formed XML packets.
- Understand message data types.

The preference in Jabber is to move complexity from clients to the server. This makes it relatively easy to write clients (as witness the wide variety of Jabber clients available today) as well as to update the functionality of the system (i.e., without forcing users to download new clients). Jabber clients communicate with the server in XML through TCP sockets over port 5222, and do not normally communicate with each directly. In practice, many of the low-level functions of the client (e.g., parsing XML and understanding basic Jabber XML such as `<message/>`, `<presence/>`, and `<iq/>`) are handled by Jabber client libraries, enabling client developers to focus on the user interface.

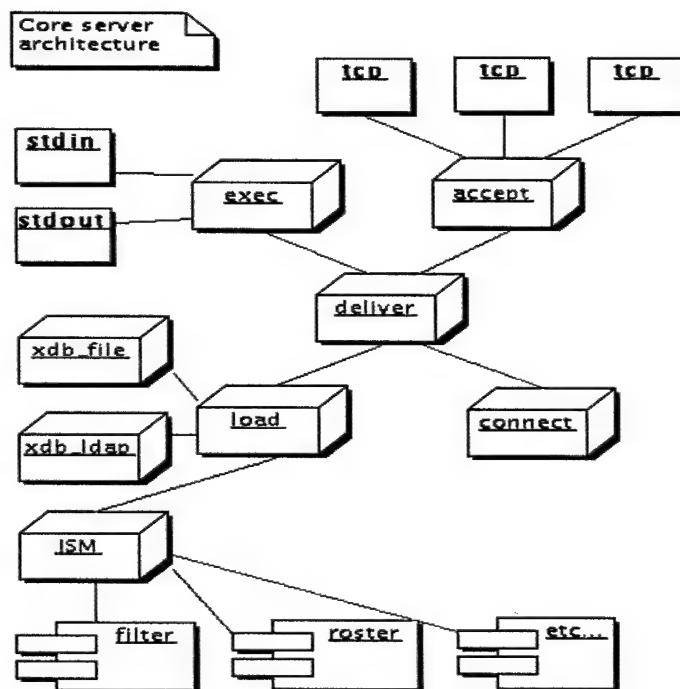
## XML Data Format

XML is an integral part of the Jabber architecture because it is of utmost importance that the architecture be fundamentally extensible and able to express almost any structured data. (Specifically, Jabber utilizes XML Streams for client-server and server-server communication. The XML Stream is always initiated by the client to the server, and the lifetime of the XML Stream is directly associated with the lifetime of that user's online session.)

While Jabber is strongly committed to XML, it is at the same time agnostic with regard to the delivery medium: there are no inherent restrictions to the delivery system, and no knowledge within the architecture of the delivery system. This is to enable, among other things, the building of transports that provide transparent messaging to third-party services. However, within the Jabber system, the transport speaks XML, as does every other component in the Jabber system.

## High-Level Server Architecture

The Jabber server consists of multiple components that handle logically separate functions within the Jabber system. At the heart of the server lies a deliver component whose sole function is to direct serialized XML from one base component to another. There are four such base components: accept, connect, exec, and load. All of the base components deserialize XML input for delivery to other base components and reserialize XML for use by components that are downstream from the base components. Here is a high-level view of the architecture just described:



On server start-up, the components of the Jabber server register callbacks for their responsibilities with the main Jabber daemon (as defined in the server configuration file), and then handle packets that are associated with those responsibilities (thereby defining the **Delivery Logic** for all packets). The core Jabber server includes components that handle the following common tasks:

- session management
- client-to-server communication
- server-to-server communication
- DNS resolution
- user authentication
- user registration

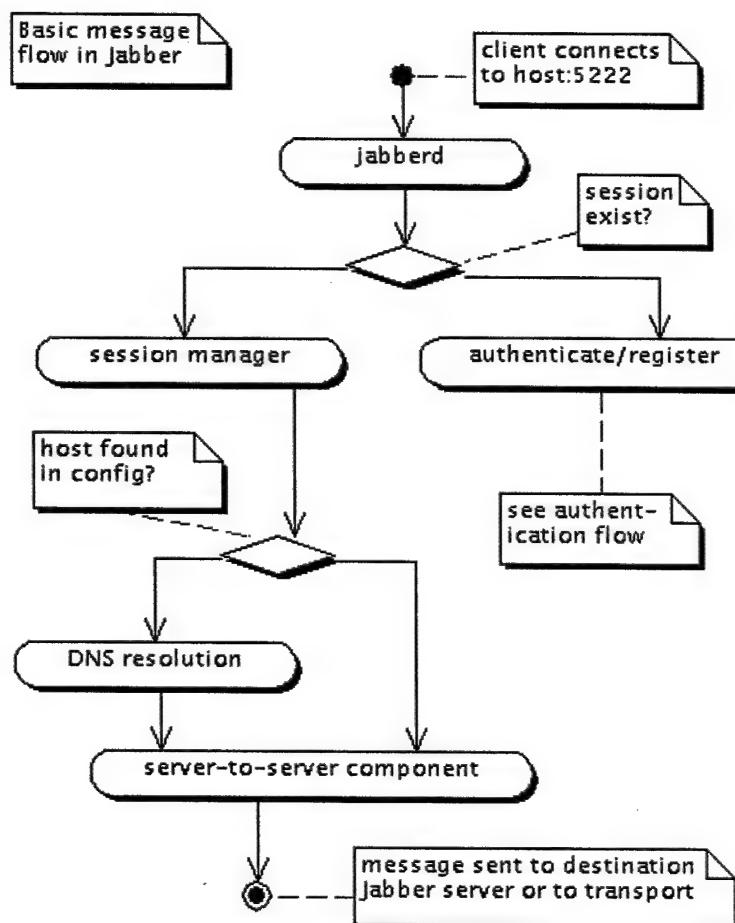
- database lookups
- storing messages for offline users
- storing and retrieving vCards
- filtering messages based on user preferences
- group chat (many-to-many communication)
- system logging

In addition, the core server can be supplemented with "transports" designed to handle protocols that are foreign to Jabber's open XML format (see [Transports](#) for details). These transports function naturally as components within the overall server architecture.

### Basic Message Flow

A good entrée to Jabber architecture is to look at the flow of a typical message through the server. (While the XML 'message' element is only one of the three main elements in Jabber's open XML protocol, it is the one most central to the purpose of Jabber: to route information from one point to another using XML.)

Here is a diagram of that flow:



The Jabber server (here represented by the term 'jabberd', short for "Jabber daemon") expects to receive packets of type 'message' in the context of a user session on that host,

which normally will take place through a dedicated TCP socket on port 5222 (or port 5223 if SSL is enabled and in use). If a session does not exist, jabberd will initiate the authentication flow as described below under **Authentication**. If a session does exist, the message packet will be sent to the Jabber session manager component ('JSM' for short).

Here is a sample of what the XML might look like:

```
<message
  to='psaintandre@aim.jabber.org'
  type='chat'
  <body>Hey, the AIM transport is working great!</body>
</message>
```

Next, the JSM checks the hostname of the destination server against the list of names contained in the Jabber server's internal configuration file. Often the hostname will be defined; for example, aim.jabber.org is defined in the config file on Jabber.com's server to point to the AIM Transport for that host (which could be on a separate machine). If the hostname is not defined in the config file, the 'dnsrv' component will resolve the hostname to an IP number and port. Either way, the message packet will next be sent on to the server-to-server ('s2s') component for the host in question, in this example jabber.org. The server-to-server component will be sent directly to the appropriate external Jabber server (e.g., jabber.org) or to a transport on this host. In this example, the message packet is intended for delivery to an address on aim.jabber.org, so the packet will be sent to the AIM Transport on jabber.org for subsequent delivery to an AOL Instant Messenger account. In either case, the end result is that a message has flowed from a Jabber client through a Jabber server to either another Jabber server or a foreign IM system.

## Authentication

As mentioned already under **Basic Message Flow**, messages and presence notification are sent in Jabber within the context of a user's session on a host machine running the Jabber server. In the terms of the Jabber protocol, this session is maintained by means of two XML streams, one from the client to the server and one from the server to the client. However, in order for the server to create a session, it must first authenticate the user.

The authentication flow begins when the client connects to the host and initiates an XML stream. Immediately, the Jabber server checks for a packet of type 'iq' (short for info/query) and subtype 'query' in the 'jabber:iq:auth' namespace, containing authenticating information for the user. This authenticating information must consist of a username and resource along with a plaintext password (for obvious reasons this is discouraged), a password scrambled using the SHA1 algorithm (this authentication scheme, a.k.a. "digest authentication", is the default), or appropriate data for zero-knowledge authentication.

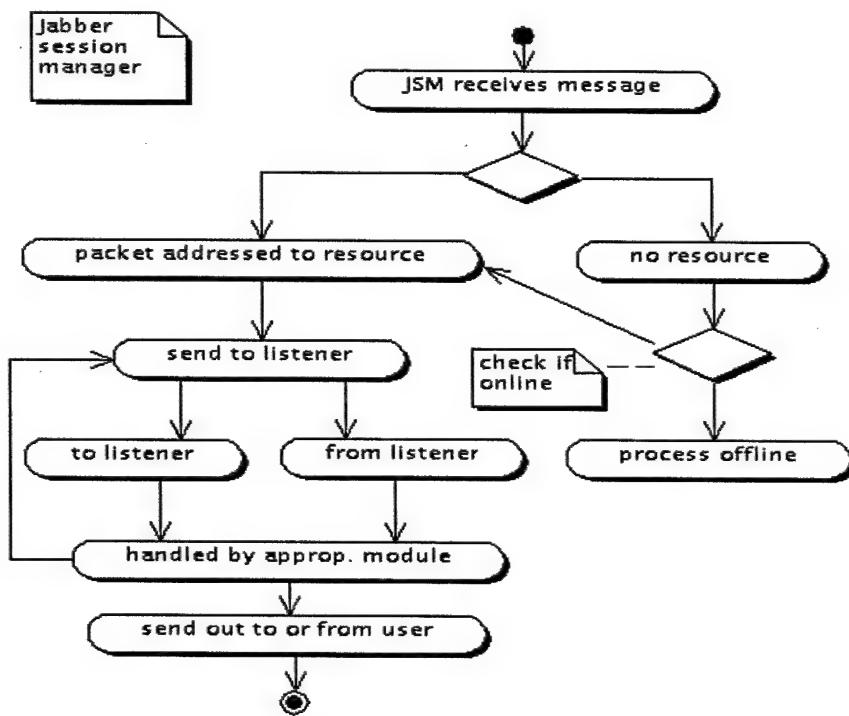
Once this information is received, the XML parser passes control to the 'deliver' component of the Jabber server, which will begin to buffer incoming XML if the client continues to send XML without waiting for authentication. The host (usually, but not always, in the form of the JSM) will then pass the authentication packet to the 'xdb' component of the Jabber server. The xdb component ('xdb' stands for "Xml Data Base") will send the packet to whichever sub-component has registered for that type of

authentication packet: for example, plaintext authentication packets might be checked against XML files on the filesystem using the 'xbd\_file' sub-component, whereas digest authentication packets might be checked against LDAP using the 'xdb\_ldap' sub-component. All that the deliver component needs to do is hand off the authentication packet to the xdb component, which will send it to the appropriate sub-component. In addition, to improve performance, the xdb\_ldap component has its own thread pool, which functions in a way similar to the model used for **Threading** in the session manager.

The xdb component will return the result of the authentication query to the host (again, usually the JSM). If the authentication failed, the server will return error code 401 to the client and will not initiate a session. If the authentication succeeded, the JSM will start a session (and free up the XML buffer if necessary). From that point forward, all presence, message, and iq elements will be passed back and forth in the context of a user session until the client or server terminates the session by sending a closing stream tag (</stream>).

### Jabber Session Manager

Here is the activity flow of the Jabber session manager:



As mentioned, the Jabber session manager component (often shortened to 'JSM') handles packets of type message, presence, and iq to and from a Jabber user who is connected to a Jabber host. However, the JSM will also handle packets intended for a user while that user is offline. For example, let us say that you send a message to me via my Jabber ID (stpeter@jabber.org) even though I am not online. The JSM will handle that message appropriately, most likely by storing it until I am again online.

The JSM differentiates between online and offline users by looking for the 'resource' element in the XML stream (the 'resource' is the device, client, or location with or from which I am connected; examples of these might be 'laptop', 'Gabber', and 'home').

Normally, a user is offline if the packet does not contain a resource element. However, sometimes the resource element is left off in error, so the JSM checks to see if the user really is offline before sending a packet to the 'offline' component, which might (for example) store a message or retrieve a vCard.

If the user is online, the message, presence, or iq packet is not sent to the offline component but instead is handled by the JSM. In essence, any such packet can have only one of two possible states: either it is intended to be delivered to the user or it is being sent from the user. So the JSM contains two listeners that listen for packets "to" or "from" the user and then route them to the appropriate module within the Jabber server. Once the appropriate module has handled the packet, the packet is sent back to the listeners for further processing by more modules or, if all processing has been completed, the packet is sent out to or from the user.

It may be helpful to look at an example. Let's say that I receive a message from `foobar@jabber.org`. I am online, so the message is sent to the JSM. The "to listener" hears about a packet that is intended for me and sends out a call to the modules that have registered with the JSM. The first module that responds is `mod_filter`, which sorts through incoming messages according to criteria set by the user. In this case (since I never seem to get anything critically important from our friend `foobar`), I have configured `mod_filter` to forward all messages from `foobar@jabber.org` to my email box using the hypothetical but planned SMTP Transport. Let us say that `mod_filter` reformats the message so that the host of the intended recipient is now `smtp.jabber.org` instead of `jabber.org`, then sends the packet back to the "to listener". Another call goes out to the registered modules, but none reply so the packet is sent to `stpeter@smtp.jabber.org`, which duly forward it to my email inbox.

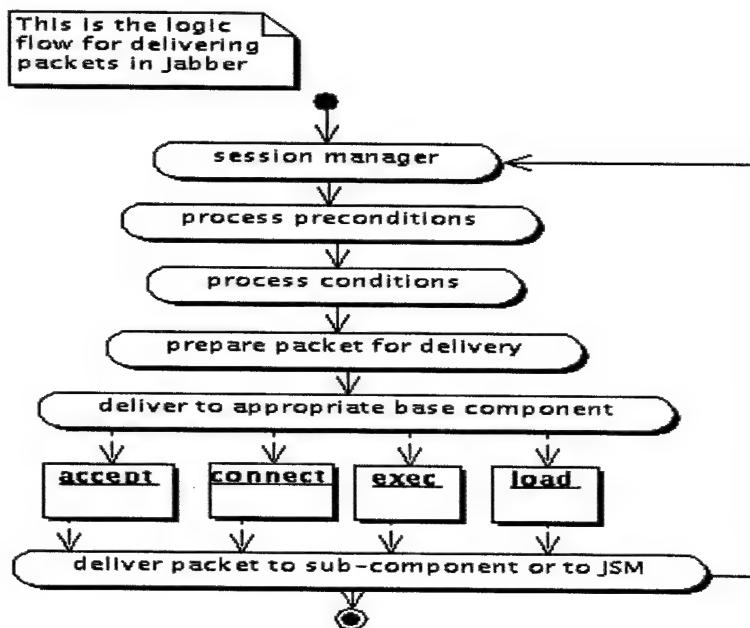
The important thing to note is that this process is iterative, so that multiple modules may handle a packet before it is finally sent to or from a user. This gives the JSM a great deal of flexibility and extensibility, since new functionality can be added to the server simply through the addition of a new module (and appropriate changes to the server configuration file) without making changes to the JSM itself or to existing modules.

## Threading

The Jabber session manager uses threading to improve performance. On server start-up, a number of threads are assigned to the thread pool (the exact number is determined in the configuration file). As message packets are fed to the session manager through the base load component from other parts of the system, the session manager dynamically pulls unused threads from the thread pool and associates them with the message ports for which queued packets are intended. (A "message port" is a data structure that supports a client connection.) If no threads are available in the pool, the session manager may (but is not required to) create a new thread and associate it with the appropriate message port.

## Delivery Logic

The deliver component is the heart of the server, since it moves data from one base component to another. The logic for handling data at this level is shown below:



Once a packet is delivered to one of the base components (accept, connect, exec, or load), it may be sent to a sub-component such as jpolld or xdb\_ldap for further processing.

An example of a precondition might be an xdb result (e.g., from a database get) that needs to be handled. An example of a process condition might be the addition of a route namespace for use within JSM. And an example of changing a packet for delivery might be a change in the format of the message, e.g. by adding a from address.

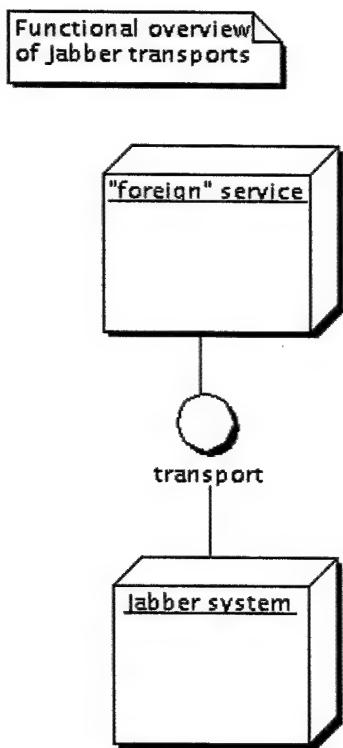
## Transports

Although the construction of a robust, XML-based messaging system is the core goal of the Jabber project, an important sub-goal is the achievement of interoperability between messaging systems. Fundamentally, the Jabber project contributes to interoperability by making its protocol completely open. However, it also contributes by enabling communication between Jabber's open XML format and numerous non-Jabber formats through the use of what in the Jabber world are called "transports".

When a Jabber user sends a message to a user on a foreign system, the delivery of that message involves the work of a transport component. The user's Jabber client sends a message to the Jabber server intended for a user on a foreign IM system, denoted by a Jabber ID that contains the name of the foreign system (e.g., psaintandre@aim.jabber.org). The Jabber server then routes the data to the appropriate transport application. If the transport is local (running on the same machine), the Jabber server communicates directly to it. If the transport is running remotely (on another machine), then the local server passes the packet to the remote server, which then passes it to the appropriate transport. Once the transport receives the XML packet, it

"transforms" the message (or instructions) into a native packet which is readable by the other IM network, and passes it to that IM network.

Here is a high-level view of what Jabber transports do:



In essence, a transport implements the proxy pattern. Most transports contain their own small session manager, which translates Jabber XML into and out of the "foreign" (non-Jabber) protocol for presence, messaging, and (in some cases) info/query requests. In general, when a user logs onto Jabber, a thread is created in the transport to handle all communications to and from that user.

In some cases the translation to and from the Jabber protocol is fairly straightforward, for instance when the foreign protocol is well-documented. In other cases, the translation is made more difficult by the closed or undocumented nature of the foreign protocol.

### Subscriptions

A Jabber entity can subscribe to the presence of any other entity (i.e., anything with a **Jabber ID**). A subscription is essentially an agreement by the "subscribee" to send presence changes to the subscriber. This information is stored in both the subscriber's roster and the subscribee's roster. When I authenticate and create a session on the server, my presence information is stored within the Jabber Session Manager. Then whenever I change my presence information, the <presence/> packet is handled by the server, which does a lookup in my roster and then forwards the presence packet to all the Jabber entities that have subscribed to my presence.

Subscriptions fall into the following categories, which are stored in the rosters of the entities involved:

- to -- another entity sends presence information to you
- from -- another entity receives presence information from you
- both -- both you and the other entity send and receive presence information from one another
- none -- neither you nor the other entity send or receive presence information from the other

The entity sending presence does not have to be another Jabber user, but instead can be an outside service such as a data feed or a non-Jabber IM system. In the latter case, subscriptions to users on the non-Jabber system are handled through a transport, and the Jabber user registers with the appropriate transport (e.g., icq.jabber.org) in order for presence to be passed on to users of the non-Jabber system. Once the Jabber user has successfully registered, the transport needs to know whenever the owner comes online, so it sends a presence subscription request to the submitter. A special presence subscription packet is sent with a "from" attribute generated by the transport, with embedded data needed to login to the native protocol.

The Jabber server maintains a list of each user's subscriptions (usually in a spool directory on the filesystem, although this information may also be stored in a database). This list is called a roster and is similar to what in other IM systems is called a "buddy list". The roster in Jabber is stored on the server and thus can "follow" the user from location to location and computer to computer. The Jabber server automatically adjusts the roster to reflect subscription types when people authorize or refuse subscription requests. Rosters can also contain other information about specific users, such user nicknames and the "groups" to which that user belongs. This information can be used by the client to display the roster in an appropriate interface, e.g., a treeview.

### **Jabber IDs**

Within Jabber there are many different entities that need to communicate with each other. These entities can represent transports, groupchat rooms, or a single Jabber user. Jabber IDs are used both externally and internally to express ownership or routing information. Key characteristics of Jabber IDs include:

- They uniquely identify individual objects or entities for communicating instant messages and presence information.
- They are easy for users to remember and express in the real world.
- They are flexible enough to enable the inclusion of other IM and presence schemes.

Each Jabber ID (or "JID") contains a set of ordered elements. The JIDs are formed of a domain, node, and resource in the following format:

[node@]domain[/resource]

The Jabber ID elements are defined as follows:

- The Domain Name is the primary identifier. It represents the Jabber server to which the entity connects. Every usable Jabber domain should resolve to a Fully Qualified Domain Name.
- The Node is the secondary identifier. It represents the "user". All Nodes live within a specific Domain. However, the Node is optional, and a specific Domain (e.g., conference.jabber.org) is a valid Jabber ID.
- The Resource is an optional third identifier. All Resources belong to a Node. Within Jabber the Resource is used to identify specific objects that belong to a user, such as devices or locations. Resources enable a single user to maintain several simultaneous connections to the same Jabber Server; examples might be juliet@capulet.com/balcony vs. juliet@capulet.com/chamber.

A Jabber user always connects to a server by means of a particular resource and therefore has an address of the form node@domain/resource while connected (e.g., juliet@capulet.com/balcony). However, since the resource is session-specific, the user's address can be communicated as node@domain (e.g., juliet@capulet.com), which is familiar to people since it is of the same form as most email addresses.

Note that in some circumstances messages may be sent directly to a specific resource, but in general, a message destined for juliet@capulet.com is routed based on some rules in the Jabber server, since each connection instance can have its own priority setting. Thus, if a message is just sent to juliet@capulet.com (i.e. without specifying a resource), the message is routed to the resource which has the highest priority, e.g. juliet@capulet.com/balcony.

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## APPENDIX 8

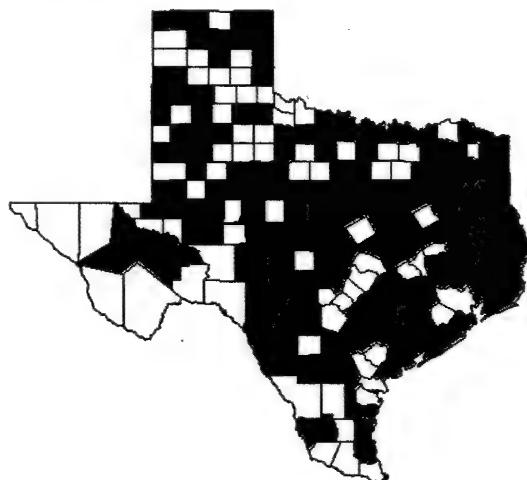
### Saving Lives in Real-Time: A Pre-Hospital Telementoring Case

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<sup>1</sup>The University of Texas Health Science Center at Houston, <sup>2</sup>Memorial Hermann Hospital

#### ABSTRACT

The development of a civilian corps of first responding emergency medical technicians (EMT) and paramedics during the past several decades, which was in many ways an extension of that which has long existed among military corpsmen, has had a very positive impact on the survival of all types of injuries and acute illnesses. The reality is, however, that the interpretation of a victim's clinical problems and therapies instituted are at this time dependent upon the individual caregiver's training, judgment, and experience. It is hypothesized that having a virtual physician present at the scene through the technology of modern telecommunications will have a favorable impact on patient outcome in many instances. Through the application of telecommunication technologies, The University of Texas Health Science Center at Houston (UTHSCH) proposes to virtually bring the physician to the scene of the incident, thereby allowing on-line physician evaluation and intervention.



Light areas = mortality at or below state average  
Dark areas = mortality above the state average

**Figure 1. State of Texas Unintended Injury, Motor Vehicle Injury, and Work-Related Injury Deaths Per 100,000 People<sup>1</sup>**

#### INTRODUCTION

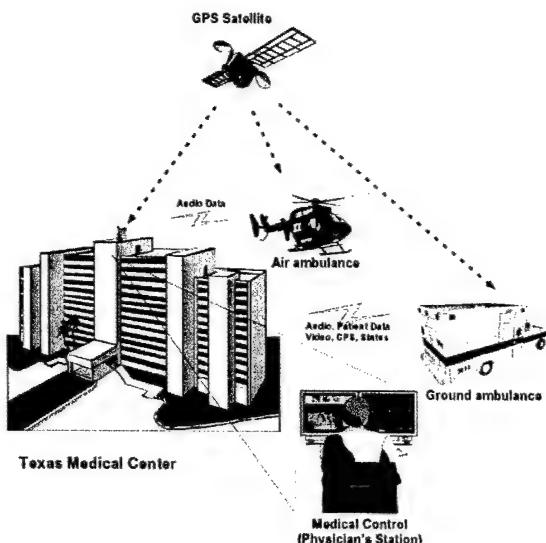
That life threatening injuries and acute illnesses occur on the battlefield, on highways and urban settings is a harsh reality. It is also a fact that early, accurate diagnoses and institution of appropriate therapy improve survival in many instances. During recent decades, significant progress has been made in reducing the interval between the onset of the problem and the institution of treatment as a result of the development of skilled medics and paramedics and improved equipment modes of rapid transportation. However, progress is often lagging in rural areas and other settings where locating the patient and getting first responders to the scene is hampered by either distance or terrain, and the sparseness of the facilities in these areas often hampers the delivery of optimal care to these patients (Figure 1).

This study was done under the Advanced Research Projects Agency (ARPA) funded project titled "Advanced Fire Protection Technologies," June 23, 1995, where UTHSCH tested a prototype "Emergency Information Resource and Response Management System."<sup>2</sup> The project's goal was to improve the diagnosis and treatment of critically ill or injured people in the field by expediting their access to medical experts at the Texas Medical Center through the utilization of various modern technologies.

The hypothesis that drives all work on the project is that pre-hospital video, audio, and physiological data transmitted between the remote site of initial patient intervention and a supervising physician will favorably impact patient outcome.

#### BACKGROUND

The objective of this project was to demonstrate the potential for improving the overall effectiveness of fire rescue and associated emergency medical services (EMS) through the use of state-of-the-art technologies.<sup>2</sup> In particular, a Cypress-Fairbanks Volunteer Fire Department (Cy-Fair EMS) civilian ambulance in the suburban Houston, Texas area was outfitted with advanced technologies, including display and data processing systems, mobile communication systems, Marquette 12-lead ECG,<sup>3</sup> a Protocol Propaq 105<sup>4</sup> vital signs monitor, and a commercial GPS



**Figure 2. System Overview**

navigation system.<sup>5</sup> Transmission of data from the ambulance to the hospital was done through 4 analog cellular telephone modems, while the 12-lead ECG was sent over a separate cellular telephone line. Figure 2 shows system overview.

The receiving hospital, Memorial Hermann Hospital (MHH) in Houston, Texas, had a computer with similar display and data processing systems. Pre-hospital vital signs and video signals were transmitted by modem to a private hospital telephone bank of 4 telephone lines. The receiving station for the Marquette 12-lead ECG had an additional telephone line.

The evaluation and merit analysis consisted of realistic scenarios that were prepared by UTHSCH and MHH Life Flight.<sup>2</sup> Baseline historical data from the Houston Fire Department for previous EMS runs were used to determine the baseline effectiveness for comparison of the new technology in this project to then current fire and EMS standard of care. During the period of study, January 1995 through July 1995, 45 total ambulance runs of different types were collected. In 14 cases of these the use of video and patient telemetry had the potential for a positive impact (2 cardio-vascular, 1 neurologic-stroke, 7 motor vehicle accident, 3 pediatric, and 1 obstetric).

#### CASE STUDY

At approximately 22:00 on a Friday night, an ambulance staffed by a emergency medical technician paramedic (EMT-P), EMT basic, EMT student and 1 of the authors (RDT) observing, responded to a 41-year-old male with history of high cholesterol, hypertension, myocardial infarction 2

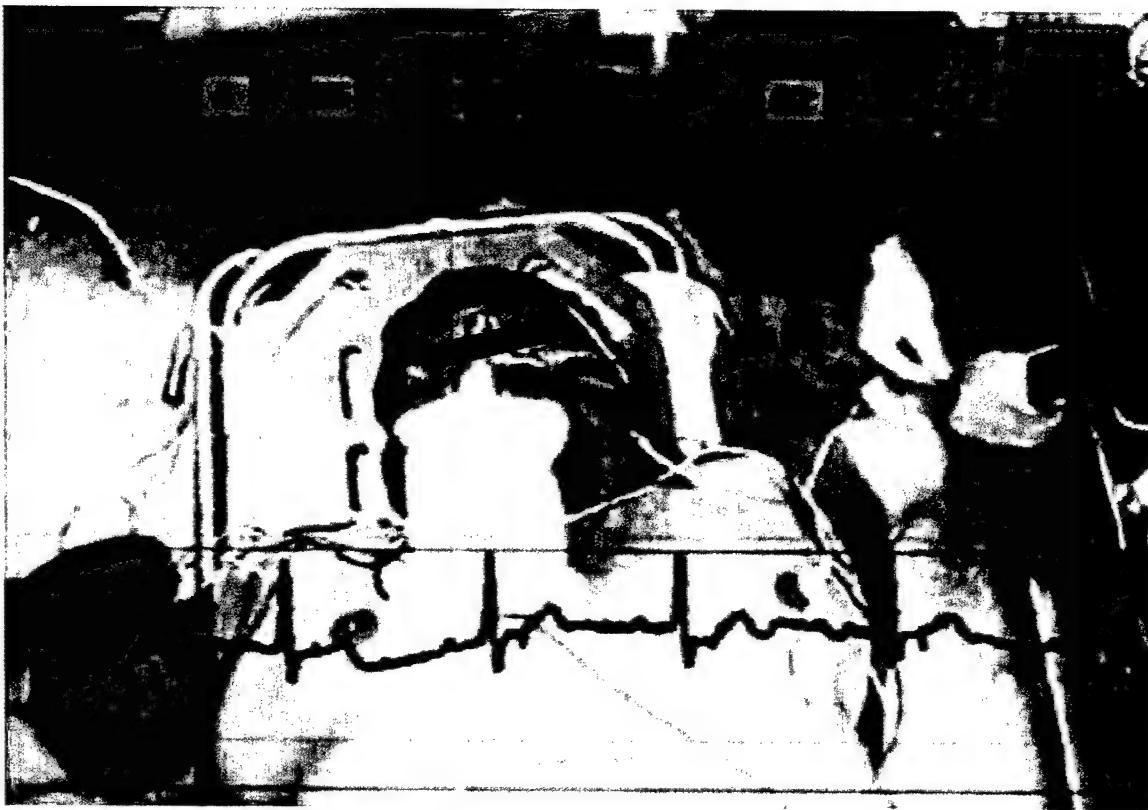
years previously, and lower GI surgery to remove polyps.

Upon arrival the patient was found in bed complaining of chest pain radiating down his left arm with weakness and slight difficulty breathing. Upon initial physical examination, skin color was good warm and dry. The Glasgow coma score (GCS) was 15. His pupils were equal and reactive and he had clear bilateral breath sounds. Abdomen was soft and non-tender although patient is obese. Extremities were unremarkable with positive distal pulses, no noted edema, positive capillary refill response. Weak grip was noted in upper extremities.

At 22:04 vitals were obtained (bp: 150/104, hr 84, rr 20) and placed on 12L/min. on non-rebreather mask. Cardiac monitoring was started, showing signs of sinus rhythm with depressed ST segment at hr 80 bpm. At 22:15 vitals were obtained (bp: 206/128, hr 100, rr 16) and was transferred to the ambulance and a 12-lead ECG was applied and showed sinus rhythm with nonspecific ST segment abnormality, and abnormal ECG. At 22:18 (bp: 206/128, hr 74) intravenous access was established of 9% saline solution.

At 22:21 (bp: 206/131, hr 74, rr 20) RDT initiated digital communication and transmitted patient data to medical control at MHH. Figure 3 shows a video/vital signs screen from this run. EMT-P called Medcon by cellular telephone and gave patient information to Carolyn Galloway, MD. Patient vitals (bp, spo2, and ECG) and video were transferred. Dr. Galloway corrected a problem with lead positioning of the ECG after viewing the video and the received 12-lead ECG. Nitro sublingual 0.4 was ordered at 22:21 and patient reported no relief. Dr. Galloway made the decision to transport by MHH Life Flight based on local ER and cardiac catheterization lab availability. Ambulance instructed to drive to a prearranged landing zone and wait for Life Flight.

At 22:24 (bp: 191/131, hr 76, rr 16, 99% spo2) Dr. Galloway ordered 10 mg Procardia<sup>TM</sup><sup>6</sup> and instructed the patient to bite and swallow, but patient declined. Chest pain continued at a rate of 8 on a 1-10 scale. At 22:27 (bp: 191/128, hr 83, 99% spo2) patient continued to experience chest pain without nausea, vomiting, dizziness, or lightheadedness. At 22:30 patient continued to be hypertensive, and Dr. Galloway ordered magnesium sulfate 4mg IV push. At 22:31 (bp 208/124, hr 91, rr 20, 100% spo2) second 12 lead ECG was sent to medical control, and remained unchanged. Dr. Galloway ordered one half adult aspirin (325mg) by mouth, but patient refused water and swallowed it. At 22:36 (bp: 184/130, hr 79, rr 20, 100% spo2) continued to monitor patient and he began to gasp for air. He still denied any chest



**Figure 3. Video and Vitals from Case Study**

pain relief. At 22:40 vitals were (bp: 194/124, hr 81, rr 20, 100% spo<sub>2</sub>)

Dr. Galloway advised to continue to monitor patient and advised that Life Flight could see the landing zone. Patient was transferred to Life Flight and proceeded by air transport. Patient was monitored and assessed by Life Flight personnel and upon arrival at MHH patient received definitive care of a cardiac catheterization within 4 hours of initial ambulance arrival. The patient returned to the community for follow-up by his local cardiologist and primary care physician within 36 hours of admission.

This case was of particular note because of the use of video imagery to correctly place the 12-lead ECG in the field. Since the patient was being continually monitored and telemetry was sent automatically to medical control, Dr. Galloway could immediately see the responses to therapy and continue advanced pre-hospital care. The presence of the 12-lead ECG and the expert interpretation via the telemedicine link was effective for the patient diagnosis. Without the advanced technologies onboard he could have been transported to the local ER, which could have dramatically delayed cardiac catheterization.

#### CONCLUSIONS

While the sample of cases may not be wholly representative of the mix of cases seen by the Cy-Fair EMS, they did illustrate the potential for benefit with advanced equipment and telecommunication technologies. The 14 cases showing positive potential for video impact, including the aforementioned case study, showed promise in this feasibility study. The success and positive impact of remote telemetry and patient video qualitatively proved the hypothesis and encouraged further research and development in this area.

#### CURRENT WORK

Based on the early lessons learned in this ARPA project, the Disaster Relief and Emergency Medical Services (DREAMS™) project started. DREAMS™ is a U.S. Army-funded consortium of scientists, medical professionals, and engineers from UTHSCH and the Texas A&M University System. The goal of the DREAMS™ Digital EMS project is to improve the diagnosis and treatment of critically ill or injured soldiers or civilians in the field by expediting their access to medical experts at trauma centers or field

hospitals through the utilization of various modern technologies. Digital EMS is testing the new systems developed in this program in varied rural, remote, and urban settings in Texas. We hope to qualify and overcome not only the technology issues while communicating with mobile distant emergency vehicles, but also to develop procedures for telementoring of remote medics and other medical personnel through the transportation and transfer of critically injured people.

The Digital EMS project is just one part of the DREAMS™ project and is designed to allow trauma and other medical specialists to treat patients more quickly by providing a "virtual" presence of a physician on the battlefield or at the emergency scene.

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3. GE Marquette Medical Systems, Milwaukee, WI
4. Welch Allyn Medical Products, Skaneateles Falls, NY
5. DeLorme, Yarmouth, ME
6. Phizer Inc, New York, NY

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## APPENDIX 9

### A Proposed Classification Scheme for Multi-Step Clinical Care Algorithms

R. Matthew Sailors, PhD

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Medical School, Department of Surgery, Houston, TX 77030

#### ABSTRACT

*While other works may have discussed what makes a good clinical algorithm, and even discussed the importance of good algorithms, there has not been a discussion of the classification of algorithms other than to say whether or not an algorithm meets the criteria to be called "good." This work presents a classification scheme that separates algorithms into five classes based on the level of detail present in the algorithm.*

#### INTRODUCTION

Increasingly, clinical care algorithms are being computerized to serve many different roles: teaching tools, quality improvement / monitoring tools, research tools, and as part of routine clinical care. As computers have no native intelligence, it is necessary to make the algorithms as detailed as possible to both streamline the implementation process and try to ensure that the computerized algorithm represents what we want to do, not just what we told the computer to do.

While other works may have discussed what makes a good clinical algorithm, and even discussed the importance of good algorithms, there has not been a discussion of the classification of algorithms other than to say whether or not an algorithm meets the criteria to be called "good."<sup>1-3</sup>

#### CLASSIFICATIONS

##### Class 0

Class 0 algorithms are often encoded only in textual form. These algorithms are usually full of the vagaries necessary to get a document through the consensus process and fail to adequately describe the decisions and actions that are required to care for the patient. The actual algorithm is often unstructured or poorly structured and may follow no sequential order based on either time or logical progression of a pathology or treatment course. Important entry or exclusion criteria and conditional values often appear at the end of the algorithm or in footnotes, if at all.

##### Class 1

Class 1 algorithms improve upon Class 0 algorithms by specifying all of the entry and exclusion criteria at the beginning of the algorithm description. The algorithm steps are coarsely structured and are arranged in a temporal or logical progression. These algorithms are usually still represented in textual form, but may also be represented in other forms.

##### Class 2

Class 2 algorithms improve upon Class 1 algorithms by explicitly defining all thresholds and decisions within the algorithms. Some action steps are also defined.

##### Class 3

Class 3 algorithms are distinguished from Class 2 algorithms by the representation format and the presence of definitions for all steps. Class 3 algorithms are represented using some structured formalism, such as flow diagrams or formal, structured text (pseudo-code).

##### Class 4

Class 4 algorithms include all of the details necessary for a non-expert or computer to negotiate the algorithm in a reliable and repeatable manner. All logical and clinical concepts are explicitly spelled out and are described in terms of patient-specific values. These algorithms are most often disseminated as either flow diagrams or encoded using a knowledge base formalism.

As it is possible for a given clinical algorithm to fulfill all of the requirements for a given classification and part of the requirements for a higher classification, it may be necessary to classify the algorithm as an intermediate value. This is done by separating the two levels with a forward slash (/), such as, "Class 3 / 4". This notation, while less precise than a decimal or true fractional notation, has the advantage of being simple and efficient.

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3. Sailors RM. Moving Arden Syntax Outside of the (Alert) Box: A Paradigm for Supporting Multi-Step Clinical Protocols. *Journal of the American Medical Informatics Association* 1998; 5:1071.

#### Acknowledgements:

Support for this work was provided by NIGMS P50 GM38529 and DAMD17-98-2-8002.

## APPENDIX 10

### ArdenML: The Arden Syntax Markup Language ( or Arden Syntax: It's Not Just Text Any More! )

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University of Texas-Houston Health Science Center  
Medical School, Department of Surgery, Houston, TX 77030

#### ABSTRACT

*It is no longer necessary to think of Arden Syntax as simply a text-based knowledge base format. The development of ArdenML (Arden Syntax Markup Language), an XML-based markup language allows structured access to most of the maintenance and library categories without the need to write or buy a compiler may lead to the development of simple commercial and freeware tools for processing Arden Syntax Medical Logic Modules (MLMs)*

#### LEVELS OF ENCODING

Borrowing the concept of levels of detail from other groups within HL7 (Health Level Seven, Inc), a numeric coding scheme for identifying the level of detail was developed and presented to the Arden Syntax Special Interest Group (Arden SIG). The levels are numbered from 0 to 4 in increasing level of detail.

##### Level 0

Level 0 encoding simply wraps existing Arden Syntax<sup>1</sup> MLMs in their entirety inside a large CDATA (character data) construct. The CDATA type is used to allow for the commonly used greater than and less than signs (">", "<") that are used as tag delimiters in XML-derived markups.

##### Level 1

Level 1 ArdenML encodes the Arden Syntax hierarchy of categories and slots. Each category becomes a collection of substructures (the slots) and each slot is represented as a separate CDATA field. It is important to note that at ArdenML Level 1 and higher, the normal category and slot identifiers and all terminators (";" / ";;") have been replaced by tags.

##### Level 2

Level 2 of ArdenML adds another layer of structure to model. The structures added to the citation and links slots in Arden Syntax Version 2 and addition structuring of the author, specialist, and keyword slots that have been proposed for Arden Syntax Version 3 first appear in ArdenML Level 2 encoding. Additional elements representing many of the coded values within Arden Syntax are also present.

##### Level 3

Level 3 encoding introduces the structuring of whole statements and control structures. ArdenML encodes the blocks of statements inside control structures as nested constructs with additional nesting of

the statement blocks that appear in *if-then-else-elseif* conditional statements or within loops. This representation simplifies the processing of the encoded MLM and is in keeping with the model of adding of additional structure to the MLM as the level of encoding increased. Tags to encode comments, identifiers, referenced MLMs, and tokens used to structure data have also been added in ArdenML Level 3.

##### Level 4

Level 4 encoding structures Arden Syntax down to the level of operators and operands. A DTD for ArdenML Level 4 has not been developed at this time, as this requires the reimplementation of the entire Arden Syntax BNF (Backus-Naur Form) in XML-based constructs. This was deemed to be unnecessary for this preliminary work product.

#### CONCLUSIONS

At this time it is not clear if encoding Arden Syntax beyond Level 2 has any real value other than as an academic exercise. However, as XML translation tools begin to multiply, ArdenML Levels 3 and 4 may become practical. ArdenML Levels 2 and 3 also show promise as intermediary forms to be used during development and maintenance of MLMs using componentized development tools.

#### FUTURE DIRECTIONS

An exploration of the use of XST (XML Stylesheet Translation) to translating MLMs into other program constructs mmimg/knowledge representations without having to build a traditional compiler is planned.

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Support for this work was provided by  
DAMD17-98-2-8002.

## APPENDIX 11

Provide the following information for the key personnel listed on the budget page.

NAME James Henry Duke, MD	POSITION TITLE Professor of Surgery		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include post-doctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
UT Southwestern Medical School-Dallas Southwestern Baptist Theological Seminary-Ft Worth A&M College of Texas Columbia University, New York Columbia University, New York Parkland Memorial Hospital, Dallas TX Parkland Memorial Hospital, Dallas TX	MD BD BS Postdoctoral Postdoctoral Residency Internship	1960 1955 1950 1967-69 1967-69 1961-65 1960-61	Medicine Divinity Chem. Eng. Biochemistry NIH General Medical Sciences General Surgery Medicine

**RESEARCH AND PROFESSIONAL EXPERIENCE:** Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. **PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.**

### ACADEMIC APPOINTMENTS

1965-66 Instructor in Surgery, The University of Texas Southwestern Medical School, Dallas TX  
 1966-69 Asst Prof of Surgery, The University of Texas Southwestern Medical School, Dallas TX  
 1969-72 Asst Prof of Surgery, College of Physicians and Surgeons, Columbia University, New York NY  
 1970-72 Visiting Professor of Surgery, Nangarhar University, Faculty of Medicine, Jalalabad, Afghanistan  
 1971-72 Chairman, Dept of Surgery, Nangarhar University, Faculty of Medicine, Jalalabad, Afghanistan  
 1972-73 Associate Professor of Surgery, The University of Texas Health Science Center at Houston Medical School, Houston TX  
 1977-87 Special Assistant to the President, The University of Texas Health Science Center at Houston  
 1978-86 Professor and Medical Director, The University of Texas Health Science Center at Houston School of Allied Health Sciences, Program in Emergency Medical Services  
 1978-82 Vice Chairman for Clinical Affairs, The University of Texas Health Science Center at Houston Medical School  
 1991-95 Vice Chairman, Department of Surgery, The University of Texas Health Science Center at Houston Medical School  
 1973- Professor of Surgery, The University of Texas Health Science Center at Houston Medical School  
 1986- Visiting Member, Graduate Faculty Texas A&M University College of Veterinary Medicine, College Station TX  
 1994- Professor of Emergency Medicine, The University of Texas Health Science Center at Houston Medical School  
 1995- Vice Chairman of Development, Department of Surgery, The University of Texas Health Science Center at Houston Medical School

### CERTIFICATIONS

1993 Advanced Trauma Life Support Provider, 1993  
 1996 American Board of Surgery, 1966  
 1970 License Practice Medicine in Texas, 1960; New York, 1970 (inactive)

### HOSPITAL APPOINTMENTS

1965-69 Attending Staff, Parkland Memorial Hospital, Dallas TX  
1965-69 Attending Staff, John Peter Smith Hospital, Fort Worth TX  
1965-69 Attending Staff, Presbyterian Hospital, Dallas TX  
1969-72 Assistant Attending Staff, Presbyterian Hospital, New York NY  
1970-72 Attending Surgeon, Nangarhar Univ, Faculty of Medicine Hospital, Jalalabad, Afghanistan  
1972-82 Attending Surgeon, Chief, Surgery B Service, Hermann Hospital, Houston TX  
1973-82 Medical Director of Emergency Center, Hermann Hospital, Houston, Texas  
1976- Founder and Medical Director of Life Flight Operations, Hermann Hospital, Houston TX  
1984-87 Medical Director, Affiliated Hospital Systems, Hermann Hospital, Houston TX  
1990- Attending Surgeon, Surgery/Trauma Service, Hermann Hospital, Houston TX  
1990- Director of Trauma/Emergency Medical Services, Hermann Hospital, Houston TX  
1990- Attending Surgeon, Harris Cty Hospital District, Lyndon B. Johnson General Hospital, Houston TX

### PROFESSIONAL EXPERIENCE

*Professional Organizations:* American Board of Surgery, American College of Surgeons, American Medical Association, American Association for the Surgery of Trauma, American Trauma Society, Association for Academic Surgery, Association of American Medical College, Division of International Medical Education, Chirurgio Society, Harris County Medical Society, Houston Gastroenterological Society, Houston Gulf Coast Chapter of the Ileitis & Colitis Foundation, Houston Surgical Society, National Association for Physician Broadcasters, Society for Surgery of the Alimentary Tract, Southeastern Surgical Congress, Southern Surgical Association, Texas Medical Association, Texas Surgical Society. *Current Committees:* Texas Department of Health, Emergency Health Care Advisory Committee; American Trauma Society, Board of Directors; American College of Surgeons Cancer Liaison Physician. *Hermann Hospital:* Emergency Medical Services Administrators Forum; Trauma Reporting Ling/Performance Improvement, Co-Chairman; Trauma Surgery Service Focus Committee; Level I Verification Team; Trauma Resuscitation Video Review, Quality Audit.

### CURRENT RESEARCH PROJECTS

Disaster Relief and Emergency Medical Services Project (DREAMSTM)  
An Open-Label, Multicenter Clinical Study to Evaluate the Efficacy and Safety of Technetium Tc-99m LeuTech Scintigraphy for the Detection of Appendicitis in Patients Presenting with Equivocal Signs and Symptoms.  
Phase II Clinical Trial Evaluating the Safety and Efficacy of Technetium Tc 99m P748 in the Detection and Localization of Pulmonary Embolism by Gamma Scintigraphy  
A Phase 2b Study to Evaluate the Safety and Efficacy of r-PAF-AH for Prevention of ARDS in Patients with Severe Sepsis or Severe Traumatic Injuries  
Phase 2B Safety and Efficacy Study of HU23F2G in Subject with Hemorrhagic Shock Technetium Tc99m Leutech Scintigraphy for Detection of Appendicitis

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Provide the following information for the key personnel listed on the budget page.

NAME Elmer V. Bernstam, MD	POSITION TITLE Clinical Assistant Professor		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include post-doctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
University of Michigan, Ann Arbor	BS	1992	Biomedical Sciences,
University of Michigan, Ann Arbor	BSE	1992	Psychology
University of Michigan, Ann Arbor	MD	1995	Computer Engineering
University of Michigan, Ann Arbor	MSE	1999	Computer Engineering
Stanford University, Stanford, CA (National Library of Medicine Post-Doctoral Fellowship)	MS	2001	Biomedical Informatics

**RESEARCH AND PROFESSIONAL EXPERIENCE:** Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.

#### PROFESSIONAL EXPERIENCE

1989-95 Research Assistant, School of Public Health, University of Michigan, Ann Arbor  
 1995-98 Internal Medicine Resident, St. Joseph's Mercy Hospital, Ann Arbor MI  
 1998- Attending Physician, St. Joseph's Mercy Hospital, Ann Arbor, Michigan  
 1998-1999 Attending Physician, Packard Community Clinic, Ann Arbor, Michigan  
 1999-01 NLM Post-Doctoral Fellow, Stanford Medical Informatics, Stanford Univ, Stanford CA  
 1999-2001 Attending Physician, Stanford University Hospitals and Clinics, Stanford, California  
 2001- Clinical Assistant Professor, University of Texas Health Science Center t Houston  
 2002- Faculty, W. M. Keck Center for Computational Biology

#### HONORS AND AWARDS

1990 Eta Kappa Nu electrical and computer engineering honor society  
 1992 B.S. Biomedical sciences and psychology awarded with distinction  
 1992 B.S.E. Computer Engineering awarded Magna cum laude  
 1998 Diplomate, American Board of Internal Medicine  
 2001 Best-poster in category at the Biomedical Computation at Stanford (BCATS 2001) symposium

#### PUBLICATIONS

Deininger RA, Lee BH, Bernstam EV, Slawecki T. (1990) NATO Advanced Research Workshop on Computer-Aided Support Systems for Water Resources Research and Management, Lisbon, Portugal, September 23-28, 1990.  
 Deininger RA, Clark RM, Hess AF and Bernstam EV. J. Am. Water Works Assn, 84: 48-52, 1992.  
 Deininger RA, Bernstam EV. J. Am. Water Works Assn, 85: 35, 1993.  
 Deininger RA, Lai KL, Bernstam EV, Mieske H, Sanford L, Skadsen J, Clark R, Rossman L. Am. Water Works Assn Proceedings of Annual Conference, San Antonio TX, p. 75-82, June 6-10, 1993.

#### PUBLICATIONS (continued)

Bernstam EV, Craig CP, Rader K, Mazzeo R. Liver abscess with foreign body as a cause of fever of unknown origin, case report and literature review. American College of Physicians, Michigan Chapter, Abstract. Traverse City, MI. September 1997.

Bernstam EV, Strasberg HR, Rubin DL. Cost-Benefit Analysis of Computer-based Patient Records with Regard to their Use in Colon-Cancer Screening. Asia Pacific Medical Informatics Conference, Hong Kong, China, September 28-9, 2000.

Bernstam E, Troyanskaya O, Chang J. Medline Query-by-Example. (2000) Biomedical Computation at Stanford Conference, Stanford, CA, October 28, 2000 [won best poster in category prize].

Bernstam EV, Ash N, Peleg M, Tu S, Boxwala AA, Mork P Shortliffe EH, Greenes RA. Guideline classification to assist modeling, authoring, implementation and retrieval. Proceedings of the AMIA Fall Symposium pp. 66-70, 2000.

Peleg M, Boxwala AA, Ogunyemi O, Zeng Q, Tu SW, Lacson R, Bernstam E, Ash N, Mork P, Ohno-Machado L, Shortliffe EH, Greenes RA. GLIF3: The evolution of a guideline representation. Proceedings of the AMIA Fall Symposium pp. 645-9, 2000.

Elkin P, Peleg M, Lacson R, Bernstam E, Tu S, Boxwala A, Greenes R, Shortliffe EH. Toward the Standardization of Electronic Guidelines. (2000) MD Computing, 17:6, pp. 39-44.

Peleg M, Boxwala AA, Bernstam EV, Tu SW, Greenes RA, Shortliffe EH. Sharable Representation of Clinical Guidelines in GLIF: Relationship to the Arden Syntax. Journal of Biomedical Informatics, 34:3, 170-181, 2001.

Meric F, Bernstam EV, Mirza NQ, Musen MA. Quality and accuracy of breast cancer information on the World Wide Web. 24th Annual San Antonio Breast Cancer Symposium December 10-13, 2001

Bernstam EV, Kamvar SD, Meric F, Dugan JM, Chang JT, Chizek SC, Stave C, Troyanskaya OG and Fagan LM. Oncology Patient Interface to MEDLINE. Proceedings of the American Society of Clinical Oncology 37th Annual Meeting 20:244a (abstract 974), 2001.

Meric F, Bernstam EV, Mirza NQ, Hunt KK, Ames FC, Ross MI, Kuerer HM, Pollock RE, Musen MA and Singletary SE. Breast Cancer on the World Wide Web: Determinants of Web Site Popularity. Proceedings of the American Society of Clinical Oncology 37th Annual Meeting 20:39b (abstract 1904), 2001.

Bernstam EV. Medline Query-by-Example (QBE) Proceedings of the AMIA Fall Symposium pp. 47-52, 2001.

Bernstam EV, Ash N, Peleg M, Tu S, Shortliffe EH, Greenes RA. Preliminary evaluation of a guideline classification system. Proceedings of the AMIA Fall Symposium pp. 863, 2001.

Phillips RC, Bernstam EV, Mork P, Lober WB, Karras BT. Modification of GEM to incorporate changes in a classification scheme. Proceedings of the AMIA Fall Symposium pp. 994, 2001.

Sagaram S, Walji W, Bernstam EV. Evaluating the prevalence, content and readability of complementary and alternative medicine (CAM) web pages on the Internet. Proceedings of the AMIA Fall Symposium 2002, in press.

Michea Y, Pancehri K, Gong Y, Bernstam EV. Availability of online communication technology on diabetes web sites: comparing Chinese, English and Spanish web sites. Proceedings of the AMIA Fall Symposium 2002, in press.

Meric F, Bernstam EV, Mirza NQ, Hunt KK, Ames FC, Ross MI, Kuerer HM, Pollock RE, Musen MA, Singletary SE. Breast Cancer on the World Wide Web: A Cross-sectional survey of Information Quality and Web Site Popularity. BMJ, in press.

Provide the following information for the key personnel listed on the budget page.

NAME Todd Richard Johnson, PhD	POSITION TITLE Associate Professor Health Informatics		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include post-doctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
The Ohio State University	BS	1984	Computer and Information Sciences
The Ohio State University	MS	1986	Computer and Information Sciences
The Ohio State University	PhD	1991	Artificial Intelligence
<p><b>RESEARCH AND PROFESSIONAL EXPERIENCE:</b> Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. <b>PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.</b></p>			
<b>EMPLOYMENT</b>			
1991-97	Assistant Professor, The Ohio State University Department of Pathology, Division of Medical Informatics, Laboratory for Knowledge-Based Medical Systems.		
1995-98	Center Faculty, Center for Cognitive Science, The Ohio State University		
1997-98	Associate Professor, The Ohio State University Department of Pathology, Division of Medical Informatics, Laboratory for Knowledge-Based Medical Systems		
1997-98	Cognitive Science Curriculum Coordinator, Center for Cognitive Science, The Ohio State University		
1998-	Associate Professor, Department of Health Informatics, School of Allied Health Sciences, The University of Texas Health Science Center at Houston		
<b>PROFESSIONAL EXPERIENCE</b>			
1990	Cognitive Science Society		
1998	American Medical Informatics Association		
<b>PUBLICATIONS (selected)</b>			
Smith, J. W. & Johnson, T. R. (1993). A stratified approach to specifying, designing, and building knowledge systems. <i>IEEE Expert</i> , 8(3), 15-25.			
Chandrasekaran, B. & Johnson, T. R. (1993). Generic tasks and task structures: History, critique and new directions. In J.-M. David, J.-P. Krivine, & R. Simmons (Eds.), <i>Second Generation Expert Systems</i> (pp. 232-272). Berlin: Springer-Verlag.			
Johnson, T. R., Smith, J. W. & Chandrasekaran, B. (1993). Task-specific architectures for flexible systems. In P. S. Rosenbloom, J. E. Laird, & A. Newell (Ed.), <i>The Soar Papers: Research on Integrated Intelligence</i> (pp. 1004-1026). Cambridge, Mass: MIT Press.			
Johnson, T. R., Krems, J. & Amra, N. K. (1994). A computational model of human abductive skill and its acquisition. In A. Ram & K. Eiselt (Ed.), <i>Proceedings of the Sixteenth Annual Conference of the Cognitive Science Society</i> (pp. 463-468). Lawrence Erlbaum Associates.			
Johnson, T. R. & Smith, J. W. (1994). Abduction in Soar. In J. R. Josephson & S. G. Josephson (Eds.), <i>Abductive Inference: Computation, Philosophy, Technology</i> (pp. 105-116). Cambridge: Cambridge University Press.			
Johnson, T. R. (1997). Control in Act-R and Soar. In M. Shafto & P. Langley (Eds.), <i>Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society</i> (pp. 343-348). Hillsdale, NJ: Lawrence Erlbaum Associates.			

#### PUBLICATIONS (continued)

Johnson, T. R., Zhang, J., & Wang, H. (1997). A hybrid learning model of abductive reasoning. In R. Sun & F. Alexandre (Eds.), *Connectionist Symbolic Integration* (pp. 91-112). Mahwah, NJ: Lawrence Erlbaum Associates.

Johnson, T. R., Wang, H., & Zhang, J. (1998). Modeling speed-up and transfer of declarative and procedural knowledge, *Proceedings of the Twentieth Annual Meeting of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Zhang, J., Johnson, T. R., & Wang, H. (1998). Isomorphic representations lead to the discovery of different forms of a common strategy with different degrees of generality. In M. A. Gernsbacher & S. J. Derry (Eds.), *Proceedings of the Twentieth Annual Meeting of the Cognitive Science Society* (pp. 1188-1193). Hillsdale, NJ: Lawrence Erlbaum.

Wang, H., Johnson, T. R., & Zhang, J. (1998). UEcho: A model of uncertainty management in human abductive reasoning. In M. A. Gernsbacher & S. J. Derry (Eds.), *Proceedings of the Twentieth Annual Meeting of the Cognitive Science Society* (pp. 1113-1118). Hillsdale, NJ: Lawrence Erlbaum. [This paper won the 1998 Marr Prize for best Student paper]

Johnson, T. R. (1998). Acquisition and transfer of declarative and procedural knowledge. In F. E. Ritter & R. M. Young (Eds.), *Proceedings of the Second European Conference on Cognitive Modelling* (pp. 15-22). Nottingham, UK: Nottingham University Press.

Zhang, J., Johnson, T. R., & Wang, H. (1998). Order effects and frequency learning in tactical decision making. *Thinking and Reasoning*, 4(2), 123-125.

Aoki, N., Shek, M. C., Johnson, T. R., Schreiber, M., Holcomb, J. B., Wall, M. J., Cone, R. W., & Beck, J. R. (2000). Multiperspective Comparison Of Abbreviated injury Scale (AIS), International Classification of Diseases, and Diagnosis Related Groups, *AMIA 2000 Annual Symposium*.

Wang, H., Zhang, J., & Johnson, T. R. (2000). Order Effects in Human Belief Revision. In *Proceedings of the Twenty Second Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Johnson, T. R., Wang, H., & Zhang, J. (2000). Declarative and Procedural Learning in Alphabetic Retrieval. In *Proceedings of the Twenty Second Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Johnson, C., Johnson, T. R., & Zhang, J. (2000). Increasing Productivity and Reducing Errors through Usability Analysis: A Case Study and Recommendations, *Proceedings of the American Medical Informatics Association Annual Symposium*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Chuah, J., Zhang, J., & Johnson, T. R. (2000). The Representational Effect in Complex Systems: A Distributed Representation Approach, *Proceedings of the Twenty Second Annual Meeting of the Cognitive Science Society*.

Turley, J. P., Johnson, C., Johnson, T., & Zhang, J. (2001). A clean slate: initiating a graduate program in health informatics. *MD Computing*, 18(1), 47-48..

Johnson, T. R., Turley, J. P., & Patel, V. L. (2001). Cognitive Differences in Chart Reading: A Comparison of Nurses and Physicians. In *Proceedings AMIA Fall Symposium*.

Johnson, T. R., & Krems, J. F. (2001). Use of current explanations in multicausal abductive reasoning. *Cognitive Science*, 25, 903-939.

Johnson, T. R., Wang, H., Zhang, J., & Wang, Y. (2002). A model of spatio-temporal coding of memory for multidimensional stimuli. In W. Gray & C. Schunn (Eds.), *Proceedings of the Twenty-Fourth Annual Conference of the Cognitive Science Society* (pp. 506-511). Mahwah, NJ: Lawrence Erlbaum Associates.

Wang, H., Johnson, T. R., Zhang, J., & Wang, Y. (2002). A study of object location memory. In W. Gray & C. Schunn (Eds.), *Proceedings of the Twenty-Fourth Annual Conference of the Cognitive Science Society* (pp. 920-925). Mahwah, NJ: Lawrence Erlbaum Associates.

Zhang, J., Patel, V. L., Johnson, T. R., & Shortliffe, E. H. (2002). Toward an action based taxonomy of human errors in medicine. In W. Gray & C. Schunn (Eds.), *Proceedings of the Twenty-Fourth Annual Conference of the Cognitive Science Society* (pp. 970-975). Mahwah, NJ: Lawrence Erlbaum Associates.

Johnson, T. R., Wang, H., & Zhang, J. Skill Acquisition: Models. *Encyclopedia of Cognitive Science*, in press.

Provide the following information for the key personnel listed on the budget page.

NAME Vijayashree Mekala, MS	POSITION TITLE Research Associate		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include post-doctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
University of Texas Health Science Center at Houston, Texas	MS	2002	Health Informatics
Houston Community College, Texas		1999	Programming in C and Java
VJINFO, Secunderabad, AP, India.	Certification	1999	Oracle 7.3/8.0
	PG Diploma	1998	Computer Applications
JSPS Govt. Homoeopathic Medial College, Ramanthapur, India	BHMS	1998	Homoeopathic Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.

#### EMPLOYMENT

1995-96 Programmer, Government Homeopathic Medical Hospital, Hyderabad, India

1997-98 Programmer/Analyst, SouthEast Distributions Ltd., India

1998-99 Programmer/Analyst, Infodat International Inc., Houston

2000-02 Graduate Assistant, Computer Services, The University of Texas Health Science Center at Houston, School of Public Health

2002- Research Associate, Department of Surgery, The University of Texas Health Science Center at Houston

#### PROFESSIONAL EXPERIENCE

Member: Healthcare Information and Management Systems Society; American Medical Informatics Association

Provide the following information for the key personnel listed on the budget page.

NAME	POSITION TITLE		
Richard Matthew Sailors, PhD	Assistant Professor-Research		
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
Vanderbilt University School of Engineering	BE	1991	Biomedical Engineering
University of Utah College of Engineering	ME	1996	Bioengineering
University of Utah School of Medicine	PhD	2000	Medical Informatics

**RESEARCH AND PROFESSIONAL EXPERIENCE:** Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.

#### ACADEMIC APPOINTMENTS

1999- Assistant Professor-Research, Department of Surgery, The University of Texas Health Sciences Center at Houston School of Medicine, Houston TX  
 1999- Adjunct Assistant Professor, The University of Texas Health Sciences Center at Houston School of Health Information Sciences, Houston TX

#### HONORS

1987-91 Maggie S. Craig Scholar, Vanderbilt University  
 1987-91 National Merit Scholar  
 1991 *Cum laude*, Vanderbilt University

#### PROFESSIONAL EXPERIENCE

**Professional Organizations:** Institute for Electrical and Electronics Engineers, 1989-. American Medical Informatics Association, 1994-. American Society for Testing and Materials (ASTM), Clinical Decision Support sub-committee (E31.15) (committee transferred to HL7. Decision Support SIG in 1997), 1995-97. Association for Computing Machinery, 1997-. Health Level Seven, Inc. (HL7), 1997-: Decision Support Special Interest Group (converted to technical committee in 1998), 1997-98; Clinical Decision Support and Arden Syntax Technical Committee (Arden Syntax split off in separate SIG in 2000), 1998-; Manager of technical description (Backus-Naur Form) for Arden Syntax (an ANSI / ISO standard), 1998-; Arden Syntax Revision Working Group/Special Interest Group, 1998-; Co-Chair Clinical Decision Support Technical Committee, 2001-; Co-Chair Arden Syntax SIG, 2001-; Clinical Guidelines Special Interest Group (new in 2001), 2001-. The University of Texas Health Science Center at Houston, School of Medicine, Wireless Networking Committee, 2000-.

**Teaching Responsibilities:** HI 5303, Clinical Decision Making, The University of Texas Health Science Center at Houston, School of Health Information Sciences. Director, Informatics Training Course, Center for Trauma Informatics Research and Development, The University of Texas Health Science Center at Houston, School of Medicine.

#### PUBLICATIONS (selected)

East, TD, Morris, AH, Wallace, CJ, Pope, D, Carlson, D., and Sailors, RM. Can pulse oximetry be used to reliably predict arterial oxygenation? *Crit Care Med.* 23:A27, 1995.

Sailors, RM, East, TD, Wallace, CJ, and Morris, AH. A Successful Protocol for the Use of Pulse Oximetry to Classify Arterial Oxygenation into four fuzzy categories. In: Gardner RM, ed. *Proceedings of the 19th Annual Symposium on Computer Applications in Medical Care*. Philadelphia: Hanley & Belfus, Inc., 1995.

East, TD, Wallace, CJ, Franklin, MA, Kinder, AT, Sailors, RM, Carlson, D, Bradshaw, R, Morris, AH. Medical informatics academia and industry: A symbiotic relationship that may assure survival of both through health care reform. In: Gardner RM, ed. *Proceedings of the 19th Annual Symposium on Computer Applications in Medical Care*. Philadelphia: Hanley & Belfus, Inc, 1995.

Sailors, RM, East, TD, Wallace, CJ, Carlson, DA, Franklin, MA, Heermann, LK, Kinder, AT, Bradshaw, RL, Randolph, AG, and Morris, AH. Testing and validation of computerized decision support systems. *Proc AMIA Annu Fall Symp* 1996, 234-8, 1996.

Morris AH, East, TD, Wallace, CJ, Franklin, M, Heermann, L, Kinder, T, Sailors, RM, Carlson, D, and Bradshaw, R. Standardization of clinical decision making for the conduct of credible clinical research in complicated medical environments. *Proc AMIA Annu Fall Symp* 199:418-22, 1996.

East, TD, and Sailors, RM. Clinical information systems in critical care (Chapter 5). In: Rane M, ed. *Clinical Information Systems*. Redmond, WA: SpaceLabs Medical, Inc. 47-93, 1997.

Sailors, RM, and East, TD. The role of the computer in monitoring (Chapter 76). In: Tobin MJ, ed. *Principles and Practice of Critical Care Monitoring*. First ed. New York City: McGraw-Hill, Inc. Health Professions Division. 1329-1354, 1997.

Sailors, RM, East TD. Clinical informatics: 2000 and beyond. *Journal of the American Medical Informatics Association*. 6(Symposium Supplement 1999):609-613, 1999

East, TD, Heermann, LK, Bradshaw, RL, Lugo, A, Sailors, RM, Ershler, L, Wallace, CJ, Morris, AH, McKinley, BA, Marquez, A, Tonnesen, AS, Parmley, CL, Shoemaker, WC, Mead, P, Thaut, P, Hill, T, Young, M, Baughman, J, Olterman, M, Goorder, V, Quinn, B, Summer, W, Valentine, V, Carlson, J, Bonnell, B, deBoisblanc, B, McClarity, Z, Cachere, J, Kovitz, K, Gallagher, E, Pinsky, M, Angus, D, Cohen, M, Hudson, L, Steinberg, K. Efficacy of computerized decision support for mechanical ventilation: Results of a prospective multi-center randomized trial. *Journal of the American Medical Informatics Association*. 6(Symposium Supplement):251-255, 1999.

Sailors, RM. Review of Medical Instrumentation: Application and Design, 3rd Edition by John G. Webster. *Respiratory Care*. 44(1):83, 1999.

Sailors, RM, and East, TD. Computerized Management of Mechanical Ventilation (Chapter 122). In: Grenvik A, ed. *Textbook of Critical Care*. Fourth ed. Philadelphia: W.B. Saunders Company. 1329-1355, 1999.

McKinley, BA, Moore, FA, Sailors, RM, Cocanour, CS, Marquez, A, Wright, RK, Tonnesen, AS, Wallace, CJ, Morris, AH, East TD. Computerized decision support for mechanical ventilation of trauma induced ARDS: Results of a randomized clinical trial. *Journal of Trauma: Injury, Infection, and Critical Care* 2001; 50(3):415-24; discussion 425, 2001.

McKinley, BA, Kozar, RA, Cocanour, CS, Marquez, A, Sailors, RM, Ware, DN, Moore, FA. Trauma resuscitation: Female hearts respond better. *Proceedings: Annual Meeting of the Western Surgical Association*, Plaza San Antonio, TX, November 11-14, 2001: 24

McKinley BA, Kozar RA, Cocanour CS, Valdivia A, Sailors RM, Ware DN, and Moore FA. Normal versus supranormal oxygen delivery goals in shock resuscitation: the response is the same. *J Trauma* Nov;53(5):825-32, Nov 2002.

McKinley BA, Kozar RA, Cocanour CS, Valdivia A, Sailors RM, Ware DN, Moore FA. Standardized trauma resuscitation: female hearts respond better. *Arch Surg*. 137(5):578-83; discussion 583-4, May 2002.

Provide the following information for the key personnel listed on the budget page.

NAME Ziazie Zhang, PhD	POSITION TITLE Assoc Professor/Assoc Dean for Research		
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include post-doctoral training).			
INSTITUTION AND LOCATION	DEGREE (IF APPLICABLE)	YEAR(S)	FIELD OF STUDY
University of Science & Technology of China	BS	1983	Biophysics & Neuroscience
University of Science & Technology of China		1986	Biochemistry & Mol Biology
University of California, San Diego		1989	Cog Psych & Human Factors
University of California, San Diego	MS	1991	Cognitive Science
University of California, San Diego	PhD	1992	Cognitive Science

**RESEARCH AND PROFESSIONAL EXPERIENCE:** Concluding with present position, list in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List in chronological order, the titles, all authors, and complete references to all publications during the past 3 years and to representative earlier publication pertinent to this application. If the list of publications in the last 3 years exceeds 2 pages, select the most pertinent publications. PAGE LIMITATIONS APPLY. DO NOT EXCEED 3 PAGES FOR THE ENTIRE BIOGRAPHICAL SKETCH PER INVESTIGATOR.

#### EMPLOYMENT

1992-98 Assistant Professor, Department of Psychology, The Ohio State University  
 1994-98 Center Faculty, Center for Cognitive Science, The Ohio State University  
 1998- Associate Professor, School of Health Information Sciences, The University of Texas Health Science Center at Houston  
 1999-01 Adjunct Associate Research Scientist, Houston Academy of Medicine, Texas Medical Center Library  
 2002- Associate Dean for Research, School of Health Information Sciences, The University of Texas Health Science Center at Houston

#### PROFESSIONAL EXPERIENCE

1998- American Medical Informatics Association  
 1996- Association for Computing Machinery  
 1996-98 Charter Member, Institute for Ergonomics, The Ohio State University  
 1989- Cognitive Science Society  
 1999-02 Chair, Faculty Governance Organization, School of Health Information Science, The University of Texas Health Science Center at Houston  
 1993 Human Factors Society  
 1996- Psychonomic Society.

#### HONORS

2002 John P. McGovern Outstanding Teacher Award, The University of Texas Health Science Center at Houston  
 2002 Recognition of Outstanding Leadership as Chair of Faculty Governance Organization, School of Health Information Science, The University of Texas Health Science Center at Houston

#### PUBLICATIONS (selected)

Zhang, J. (1991). The interaction of internal and external representations in a problem solving task. *Proceedings of the Thirteenth Annual Conference of Cognitive Science Society*. Hillsdale, NJ: Erlbaum.

Zhang, J. (1993). *External Representation: An Issue for Cognition. Behavioral & Brain Sciences*, 16(4), 774-775.

Zhang, J. (1993). The interaction between perceptual and cognitive processes in a distributed problem solving task. *Games: Planning and Learning. Papers from the 1993 Fall Symposium*, (pp. 123-131), AAAI Press Technical Report FS9302, Menlo Park, CA.

Zhang, J. & Norman, D. A. (1993). A Cognitive Taxonomy of Numeration Systems. *Proceedings of the 15th Annual Conference of Cognitive Science Society*. (pp. 1098-1103) Hillsdale, NJ: Lawrence Erlbaum.

Johnson, T. R., Zhang, J., & Wang, H. (1994). Bottom-Up Recognition Learning: A Compilation-Based Model of Limited-Lookahead Learning. *Proceedings of the Sixteenth Annual Conference of the Cognitive Science Society* (pp. 469-474). Hillsdale, NJ: Erlbaum.

Zhang, J. & Norman, D. A. (1994). Representations in distributed cognitive tasks. *Cognitive Science*, 18, 87-122.

Zhang, J. & Norman, D. A. (1995). A representational analysis of numeration systems. *Cognition*, 57, 271-295.

Zhang, J., & Wang, H. (1995). The integration of internal and external information in numerical tasks. *Proceedings of the Seventeenth Annual Conference of the Cognitive Science Society* (pp. 791-795). Hillsdale, NJ: Erlbaum.

Wang, H., & Zhang, J. (1996). Multiple-level analysis of memory dissociations. In G. Cottrell (Ed.): *Proceedings of the Eighteenth Annual Conference of the Cognitive Science Society* (pp. 702-707). Hillsdale, NJ: Lawrence Erlbaum.

Zhang, J. (1996). A representational analysis of relational information displays. *International Journal of Human-Computer Studies*, 45, 59-74.

Zhang, J., Johnson, T. R., & Wang, H. (1996). Order effects and frequency learning in belief updating. In G. Cottrell (Ed.): *Proceedings of the Eighteenth Annual Conference of the Cognitive Science Society* (pp. 708-713). Hillsdale, NJ: Lawrence Erlbaum.

Johnson, T. R., Zhang, J., & Wang, H. (1997). A hybrid learning model of abductive reasoning. In R. Sun & F. Alexandre (Eds.), *Connectionist Symbolic Integration* (pp. 91-112). Hillsdale, NJ: Lawrence Erlbaum.

Zhang, J. (1997). Distributed representation as a principle for the analysis of cockpit information displays. *International Journal of Aviation Psychology*, 7(2), 105-121.

Zhang, J. (1997). The nature of external representations in problem solving. *Cognitive Science*, 21(2), 179-217.

Zhang, J. (1998). A distributed representation approach to group problem solving. *Journal of American Society of Information Science*, 49(9), 801-809.

Johnson, T. R., Wang, H., & Zhang, J. (1998). Modeling speed-up and transfer of declarative and procedural knowledge. *Proceedings of the 20th Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Wang, H., Johnson, T.R., & Zhang, J. (1998). UEcho: A Model of Uncertainty Management in Human Abductive Reasoning. *Proceedings of the 20th Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Zhang, J., Johnson, T. R., & Wang, H. (1998). Isomorphic Representations Lead to the Discovery of Different Forms of a Common Strategy with Different Degrees of Generality. *Proceedings of the 20th Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum.

Zhang, J., Johnson, T. R., & Wang, H. (1998). The relation between order effects and frequency learning in tactical decision making. *Thinking & Reasoning*, 4 (2), 123-145.

Cimino, J. J., Teich, J. M., Patel, V. L., & Zhang, J. (1999). What is wrong with EMR? *Proceedings of American Medical Informatics Association*.

Zhang, J. (1999). The representational issues of health concepts: A cognitive perspective. *Proceedings of International Medical Informatics Association--Working Group 6 Meeting (Health Concept Representation and Natural Language Processing)*, pp44-49. Phoenix, Arizona, December 16-19.

Shortliffe, E. H., Patel, V. L., Zhang, J., & Freed, M. (2000). Slips, mistakes and faulty reasoning: The nature of human errors in medicine. *Proceedings of AMIA 2000*.

#### PUBLICATIONS (selected)

Johnson, C. M., Johnson, T. R., & Zhang, J. (2000). Increasing Productivity and Reducing Errors through Usability Analysis: A Case Study and Recommendations. *AMIA 2000 Proceedings*.

Zhang, J. (2000). External representations in complex information processing tasks. In A. Kent (Ed.), *Encyclopedia of Library and Information Science* (Vol. 68, 164–180). New York: Marcel Dekker, Inc.

Wang, H., Zhang, J., Johnson, T. R. (2000). Human belief revision and order effect. *Proceedings of the 22nd Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum.

Zhang, J., Patel, V. L., Shortliffe, T., Freed, M., & Remington, R. (2000). The nature of human error: An emerging interdisciplinary perspective. *Proceedings of the 22nd Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum..

Chuah, J., Zhang, J., & Wang, H. (2000). The Representational effect in complex systems: A distributed representation approach. *Proceedings of the 22nd Annual Conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum.

Turley, J. P., Johnson, C., Johnson, T. R., & Zhang, J. (2001). A clean slate: Initiating a graduate program in health informatics. *MD Computing*, 18 (1), 47–48.

Zhang, J., Patel, V. L., Vicente, K., & Johnson, T. R. (2001). Medical error: Is the solution medical or cognitive? *Proceedings of AMIA 2001*.

Zhang, J., Johnson, T. R., & Lu, G. (2001). The impact of representational formats on a dynamic decision making task. *Proceedings of the 3rd International Conference of Cognitive Science* (pp.212–219).

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